A380
TECHNICAL TRAINING MANUAL
MAINTENANCE COURSE - T1 & T2 (RR / Metric)
LEVEL III - ATA 70 Powerplant

LEVEL III - ATA 70 POWERPLANT

Nacelle & Engine

Engine Control/Indicating & FADEC Systems

Theory System

AIRBUS Documentation-Complementary Info.

Fuel, Oil, Air & Ignition/Starting Systems

Theory System

Thrust Reverser System

Theory System

NACELLE & ENGINE COMPONENT LOCATION (3)

A/C Zone 400

Cowling

NOTE: Engines Cowling open

Engine

Drain Mast

Ducts and Connections

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ENGINE MASTER CONTROL DESCRIPTION (3)

General

The ENGine MASTER lever located on the center pedestal interfaces with the fuel system and the FADEC system.
Note that the engine FIRE pushbutton also acts on the LP fuel valve.
On the fuel system, the ENGine MASTER lever acts on the LP valve and MP Shut-Off Valve (MPSOV).
On the FADEC system, the ENGine MASTER lever is used for the starting mode selection and the Engine Electronic Controller (EEC) memory reset purposes.

Low Pressure fuel valve And Airframe Shut Down Solenoid

The Master Lever is directly hardwired to the airframe shut down solenoid of the HMU. It controls also the Low Pressure fuel valve through the engine master switch relay.
Setting the switch from the 'ON' to the 'OFF' position directly energizes the airframe shut down solenoid then the MPSOV moves to the close position.
After one minute, the power off relay de energized the solenoid in order to avoid heat dissipation into the HMU.
This gives the independent authority to close the MPSOV regardless of the EEC command.

ENGine MASTER and netwok Interface

The MASTER Lever is directly hardwired to each channel of the EEC.
Then each channel sends its own discrete signal via the EEC internal data bus to the other channel.
This signal is used to keep the MASTER Lever position readable into the EEC in case of AFDX failure.
The MASTER lever is also hardwired to the IOM and interfaces with the EEC through the ADCN.
The MASTER Lever uses the ADCN signals as source to arbitrate in case of disagreement between network signals or discrete signals into the EEC.
The MASTER Lever signal acts on the metering valve servo valve of the HMU, which is the second device to turn on or off the MPSOV.
One MASTER Lever discrete signal is directly linked to the ADCN as one of the necessary parameter to launch specific tests when the engine is not running.

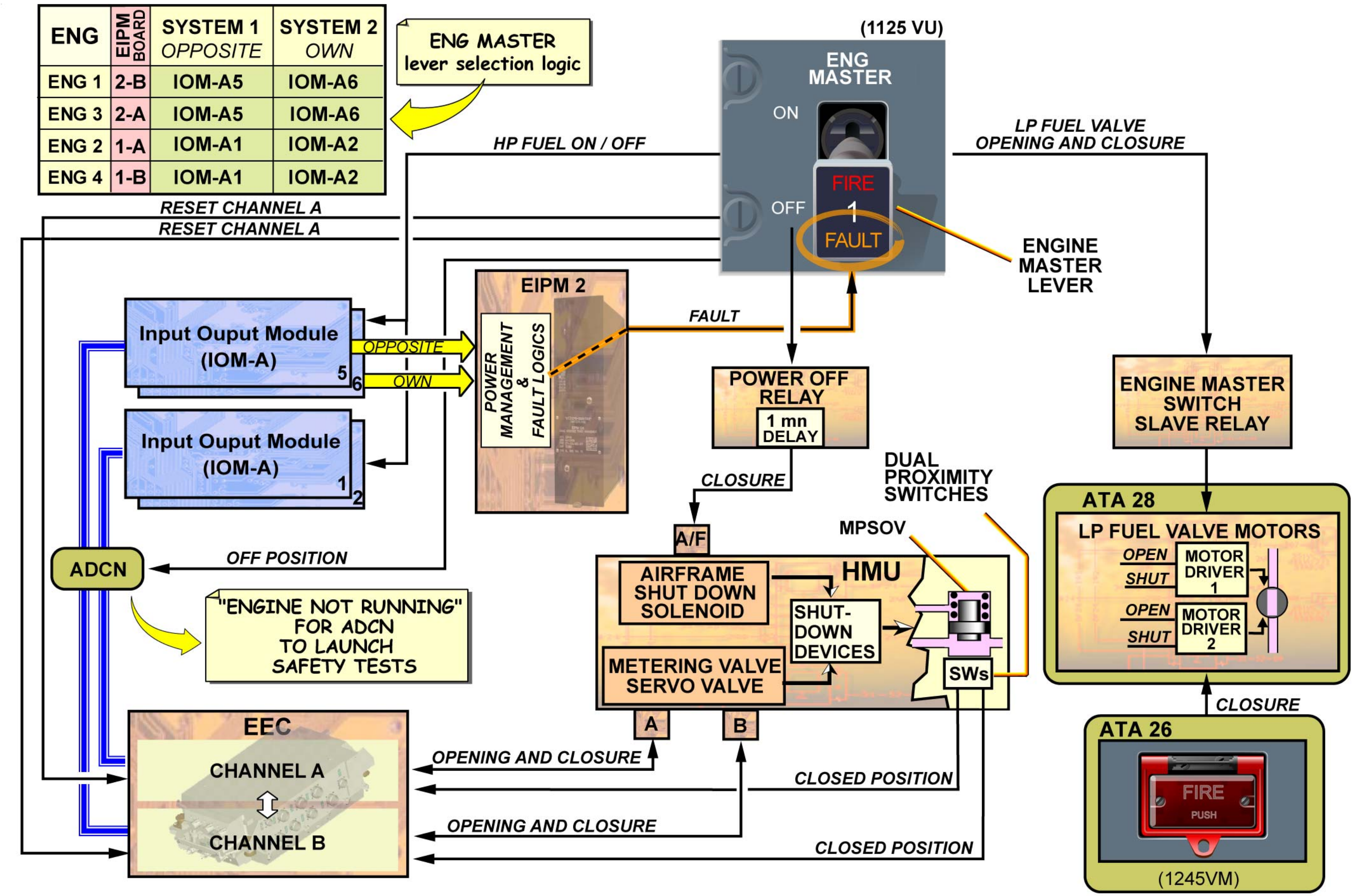
ENGine MASTER and EEC reset

Moving the MASTER lever from "ON" to the "OFF" position, closes both channel reset discrete contacts, resetting both EEC channels; all data stored in the EEC memory will be cleared.

ENGine MASTER FAULT light

The amber "FAULT" light installed located on the ENGine MASTER lever indicates a disagreement between the MPSOV position and its commanded position.
The Master lever FAULT light is managed by the EIPM, based on the digital data received from the related EEC via the IOM.

ENG	EIPM BOARD	SYSTEM 1 OPPOSITE	SYSTEM 2 OWN
ENG 1	2-B	IOM-A5	IOM-A6
ENG 3	2-A	IOM-A5	IOM-A6
ENG 2	1-A	IOM-A1	IOM-A2
ENG 4	1-B	IOM-A1	IOM-A2



GENERAL ... ENGINE MASTER FAULT LIGHT

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THROTTLE CONTROL ASSEMBLY DESCRIPTION (3)

General

The Throttle Control Assembly (TCA) design is based on a modular concept.
It is composed of 4 independent assemblies (two inboard assemblies and two outboard assemblies), each one dedicated to one engine.
Each assembly is composed of:
- A housing,
- A throttle lever,
- A thrust reverser lever (inboard assemblies, engines 2 and 3),
- A/THR instinctive disconnect push button (outboard assemblies, engines 1 and 4),

Electrical connectors.

Modulation of Engine Thrust

Except during A/THR mode, control of the forward thrust of each engine shall be achieved by modulation of the related throttle lever position.
The throttle levers can only be moved manually.
The throttles move over a sector divided into three areas separated by unique positions.
The rating selection is achieved by setting the thrust levers in the pre-determined detent point, which divide the sector.
The four throttle levers can be moved independently.
Each detent point gives the limit mode for each engine rating.

Reverse Mode

Control of the reverse thrust of either engine 2 or 3 is achieved by modulation of thrust reverser levers fitted on the throttle lever inboard assemblies.
Control of the stow/deploy sequence is achieved when the thrust reverser levers are in reverse area.
As in forward mode, the thrust reverser levers can be moved independently.
When the throttle levers are not at idle, the thrust reverser levers are mechanically locked in the stowed position.

Sensing Devices

The primary function of the TCA is to sense the commands and to generate electric signals. This positional information is received by several A/C systems.
The throttle control lever sensing devices are composed of 4 independent groups of 2 resolvers, and 4 independent groups of 3 potentiometers.
The thrust reverser lever deployed order (inboard levers only) is provided by means of a switch (one per lever).
These 2 switches signals are obtained through one track of potentiometers.

Throttle Levers and Thrust Reverser levers Detents Points And Stops

Thrust reverser lever detent point and stops are located as follows:

THROTTLE CONTROL ASSEMBLY (TCA)

THROTTLE CONTROL LEVERS DETENTS POINTS AND STOPS

0 IDLE stop: 0 °
1 MCL detent point: 30.34 °
2 MCT detent point: 42.22°
3 MAX TO stop: 54.55 °

*T HROTTLE L EVER A NGLE

THRUST REVERSER CONTROL LEVER DETENT POINT AND STOP

0 IDLE stop: 0°
4 IDLE REV detent point: 50.84 °
5 MAX REV: 96.07 °

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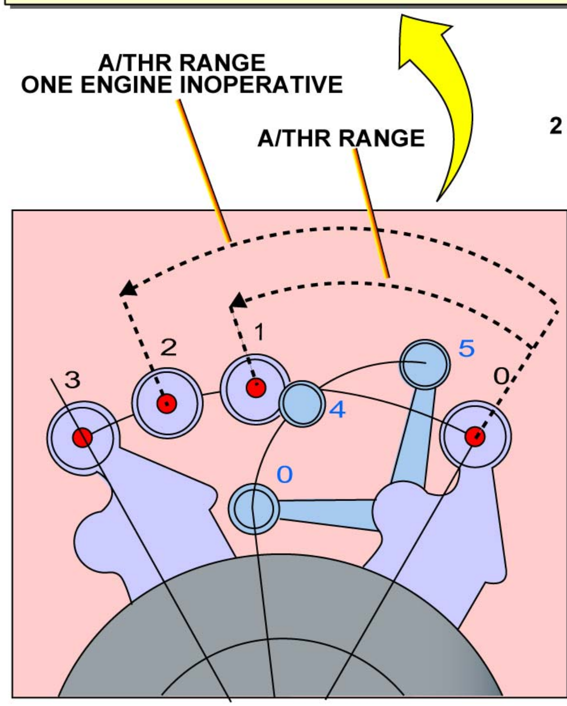

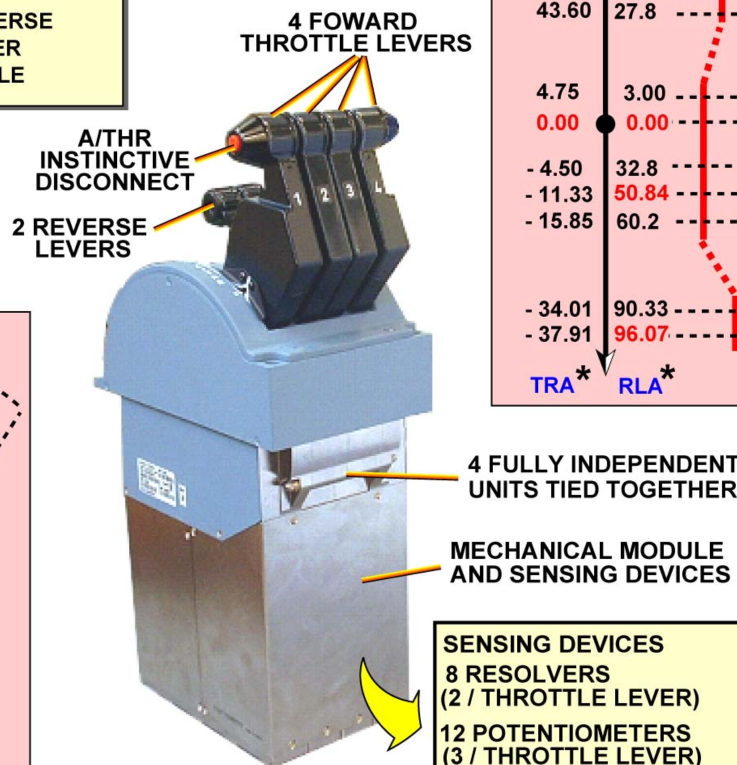

SENSING DEVICES
8 RESOLVERS
(2 / THROTTLE LEVER)
12 POTENTIOMETERS
(3 / THROTTLE LEVER)
2 SWITCHES
(THRUST REVERSE LEVER)

TRA*	TLA* / RLA*	
85.51	54.55	MAX TAKE OFF DETENT STOP
81.30	51.80	LOW END OF MTO FLAT
70.08	44.71	HIGH END OF MCT FLAT
66.18	42.22	MAX CONTINOUS DETENT POINT
62.28	39.73	LOW END OF MCT FLAT
51.46	32.83	HIGH END OF MCL FLAT
47.56	30.34	MAX CLIMB DETENT POINT
43.60	27.8	LOW END OF MCL FLAT
4.75	3.00	HIGH END OF IDLE FLAT
0.00	0.00	IDLE STOP
- 4.50	32.8	HIGH END OF REVERSE IDLE POINT
- 11.33	50.84	REVERSE IDLE DETENT POINT
- 15.85	60.2	LOW END OF REVERSE IDLE FLAT
- 34.01	90.33	HIGH END OF MAX REVERSE FLAT
- 37.91	96.07	MAX REVERSE STOP

* TRA: T HROTTLE R ESOLVER A NGLE

GENERAL ... THROTTLE LEVERS AND THRUST REVERSER LEVERS DETENTS POINTS AND STOPS

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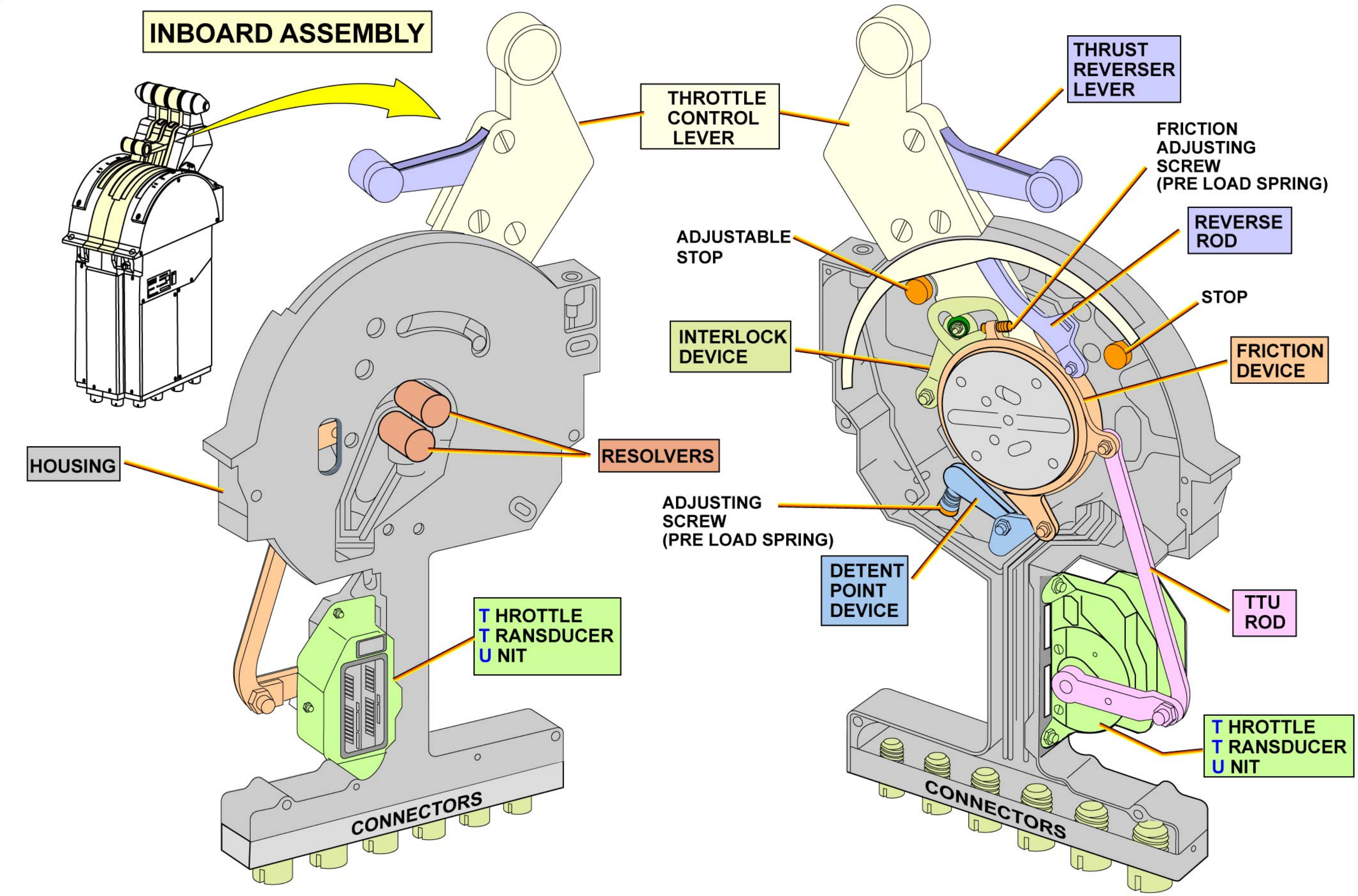
THROTTLE CONTROL ASSEMBLY DESCRIPTION (3)

Inboard and Outboard Assemblies

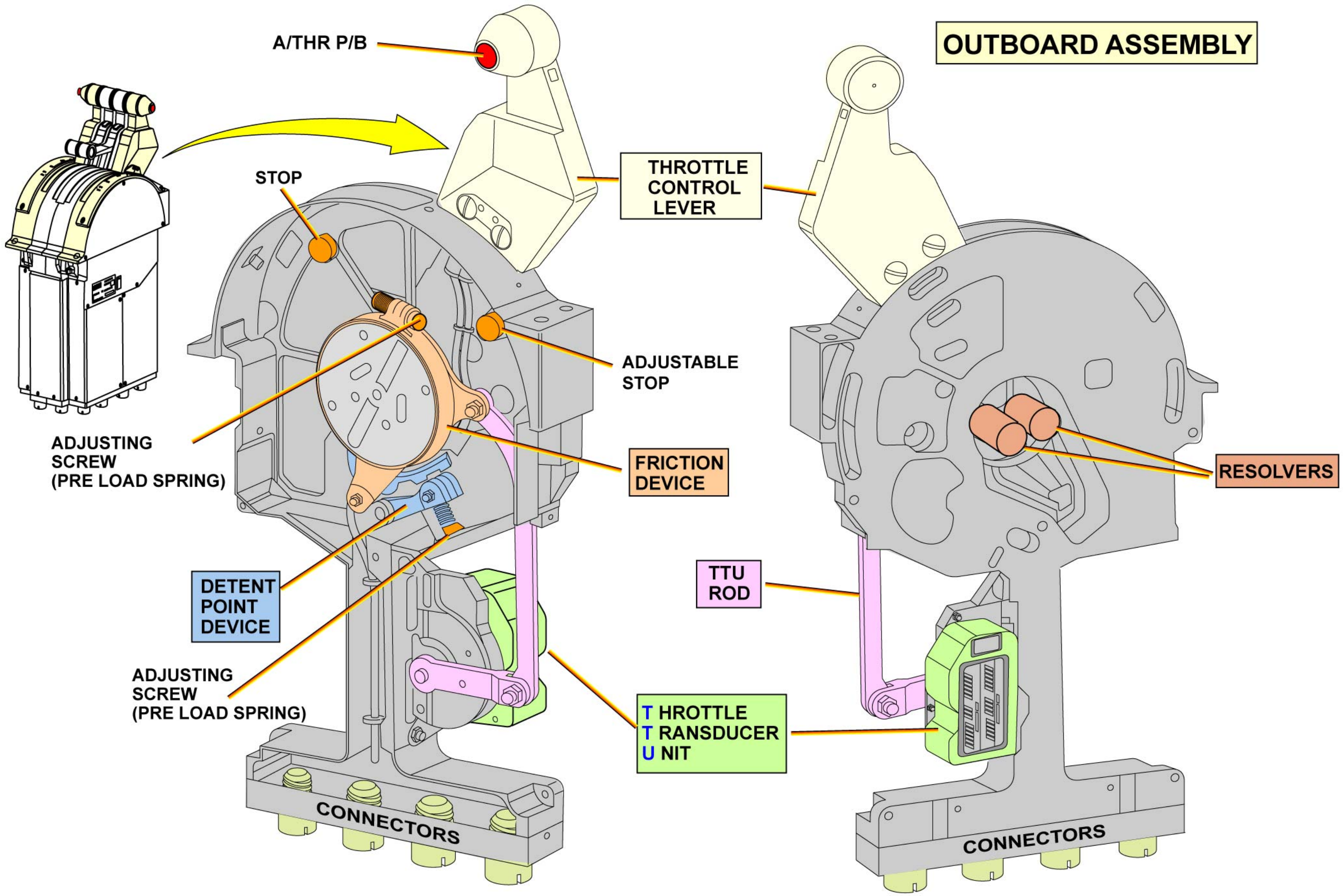
There are internal mechanical features that are installed into each inboard and outboard assembly, which are:
-The Artificial force feel device (friction force),
-The soft detent device, related to several thrust settings,
-The interlock mechanism (inboard assemblies only).
There are internal electrical features that are installed into each inboard and outboard assembly, which are:
-The 3 potentiometers and one switch (inboard assemblies) which are installed inside the Throttle Transducer Unit (TTU),
-The 2 resolvers,
-A/THR push button switch (outboard assemblies),
-The electrical connectors.

Interlock Mechanism

This mechanism is implemented only on inboard assemblies.
The purpose of the interlock mechanism is to prevent thrust reverser levers movement from the stowed position if one of the throttle levers is out of the forward idle position.
The interlock also has the following functionalities:
- Prevent the throttle lever movement forward or backward from idle position if reverse lever is raised.
-Automatic recall of the throttle lever to IDLE when thrust reverser lever is moved.
-Automatic recall of the thrust reverser lever to neutral when the throttle levers are moved from IDLE and when thrust reverser levers are positioned between 0° and 10°.



INBOARD AND OUTBOARD ASSEMBLIES - INTERLOCK MECHANISM



INBOARD AND OUTBOARD ASSEMBLIES - INTERLOCK MECHANISM

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THROTTLE CONTROL ASSEMBLY DESCRIPTION (3)

Throttle Control Assembly Interfaces

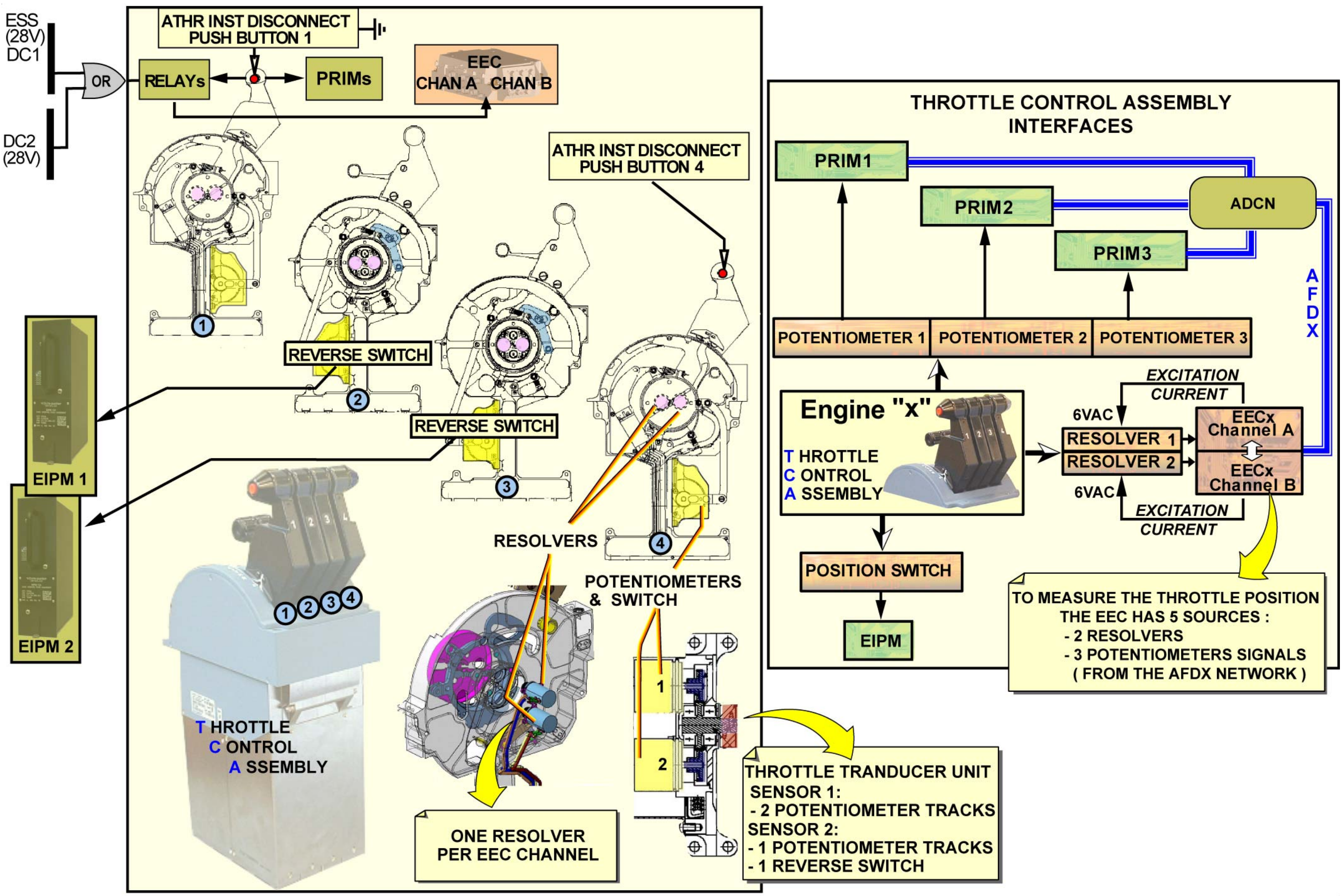
Modulation of engine thrust and selection of the thrust limit mode functions are achieved using throttle position lever sent by resolvers and potentiometers.
For each throttle lever:
- Each of the two resolvers transmits the angle information of the throttle lever to the A and B channels of the EEC (cross-communicated to the other channel).
The EEC supplies 6 VAC power to the resolvers.
- Each potentiometer transmits the angle information of the thrust lever to each PRIM.
The primary system (PRIM) supplies 10 VDC power to the potentiometers
For each thrust reverser lever:
The reverse position switch sends a discrete signal via the Engine Interface Power Management (EIPM) to control the Engine Thrust Reverser Actuator Controller (ETRAC) power.
In addition of the two resolvers signal, the EEC receives, via the AFDX network, three digital throttle angle values coming from the three PRIMs.
PRIM potentiometer information is used to consolidate resolver signal selection.

Throttle Position Selection Logic

To measure the Throttle position, the EEC has 5 sources of Throttle angle measurement:
2 Resolvers (one analog signal per channel, cross-communicated to the other channel).
3 Potentiometers signals (sensed by Flight Controls Primary Computers) received from AFDX Network.
Based on the 5 sources of throttle position, the EEC does the following logical selection:
Resolver and Potentiometers signals are all validated by the EEC (range & consistency checks).
The resolvers are selected if they are both validated and agreed by each other (digital information from potentiometers are disregarded).
When both resolvers are in disagreement, then the potentiometers are used as a referee to identify which resolver has failed.
Then, the EEC selects the valid resolver.
If there is a disagreement between a single resolver and the potentiometers, then the potentiometers are selected (via AFDX).

Instinctive Disconnect Push Button Interface

The disengagement of the A/THR function can be done manually through action on the instinctive disconnect push buttons on the throttle levers.
Both Instinctive Disconnects (A/THR disengagement) are directly hardwired to each EEC.
The EEC receives also this signal as an AFDX information from the PRIM.
The FADEC Autothrust Function is inhibited until the next EEC reset if the Autothrust Instinctive Diconnect signal is asserted continuously for more than 15 seconds.
The DC 1 ESS and DC 2 bus bar supply 28 VDC power to the instinctive disconnect pushbutton.



THROTTLE CONTROL ASSEMBLY INTERFACES - THROTTLE POSITION SELECTION LOGIC & INSTINCTIVE DISCONNECT PUSH BUTTON INTERFACE

THRUST CONTROL DESCRIPTION (3)

Engine Power Philosophy

The engine thrust is the result of several cockpit settings. To meter the fuel flow, according to its own laws, the EEC takes into account:
-The throttle control levers positions,
-The auto pilot commands (Auto Flight System, AFS),
-The KCCU (Keyboard And Cursor Control Unit) take-off data input by the flight crew.
The command signals and other relevant input signals are processed within the EEC.
Output EEC control signals are transmitted to the engine Hydro Mechanical Unit (HMU) to be converted in fuel flow and through the ACUTE (Airbus Cockpit Universal Thrust Emulator) for the indication of the thrust parameters. The EEC sends to the CDS (Control and Display System) the thrust that must be indicated via the Aircraft AFDX network.

Thrust Mode: Manual And Automatic Thrust

Two engine power setting philosophies are used in order to obtain the required thrust, manual and automatic.
In the manual mode, the Engine Electronic Controller (EEC) receives a command signal from the Throttle Resolver Angle (TRA) to compute the thrust.
Alternatively, in accordance with the Throttle Lever Angle (TLA/detent points), when the Automatic Thrust (A/THR) is activated, the Auto Flight System (AFS) sends a computed N1 Target to the EEC to set the thrust.
During Take-Off the A/THR function is engaged but not active.

Memo Thrust Mode

This is a transitive mode of thrust control between the autothrust mode and the manual mode.

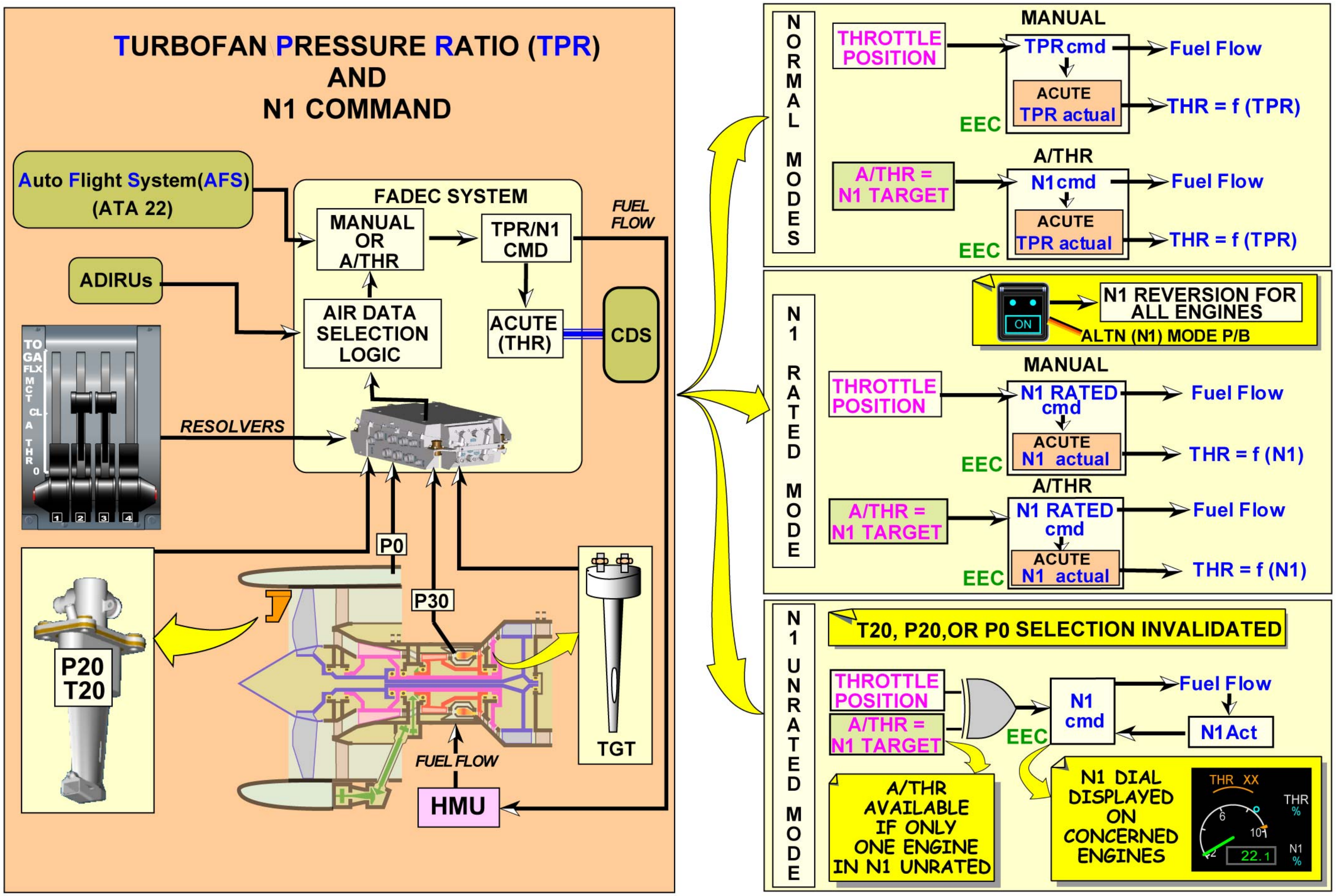
When the autothrust mode is deactivated and the throttle levers are set on the max continuous or max climb detent points, the EEC will enter the memo thrust mode.
In this mode the EEC prior to the exiting autothrust mode locks the thrust demand. This is to prevent potential thrust step changes, which may occur when reverting from autothrust to manual mode.

Thrust Setting: TPR Mode And N1 Mode

There are two EEC internal thrust laws to meter the fuel flow.
The "Turbofan Pressure Ratio" (TPR) law is the normal operating mode to compute the thrust. The selected parameters for TPR thrust control are:
P20/T20: LP compressor inlet pressure/ temperature.
P30: Combustor inlet pressure.
TGT: Low pressure turbine inlet temperature.
The N1 law is activated as a back-up mode if the TPR mode fails.
In manual or in A/THR modes, the EEC dedicated to each engine adapts the metered fuel flow to set the thrust. The EEC prevents the thrust from exceeding the limit related to the throttle lever position in both manual and automatic modes.
The EEC controls the engine to an N1 reversionary schedule as a result of cockpit command (ALTerNate mode push button) or loss of TPR parameters.
There are two forms of N1 reversionary control:
-Rated N1 Reversionary Mode:
The TPR command is converted into an N1 command. The EEC calculates N1 command using a simple comparison table "N1 versus TPR" and the engine is controlled using this N1 command.
-Unrated N1 reversionary mode:
The EEC sets the forward idle detent position equal to idle N1 and the max take-off detent position equal to "red line" N1. The EEC then uses a graphical comparison table such that the N1 versus TRA profile is equivalent to the TPR versus TRA profile. The engine is then controlled using this N1 command.

Either in TPR or in Rated or Unrated N1 mode, the manual mode or A/THR mode can be achieved.

Note: A/THR mode is still available if no more than one engine reverted to N1 unrated.



ENGINE POWER PHILOSOPHY - THRUST MODE: MANUAL AND AUTOMATIC THRUST ... THRUST SETTING: TPR MODE AND N1 MODE

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THRUST CONTROL DESCRIPTION (3)

Engine Power Philosophy (continued)

Commanded Thrust and Acute Parameter Calculation (Summary)

The following table shows an overview of the relationship between operating phase, commanded thrust and ACUTE parameter calculation.

Operating Phase		Commanded Thrust	ACUTE Parameter calculated from:
Manual Thrust Mode	TPR Mode	TPR Command = f (Throttle)	FN = f (TPR)
	N1 reversionary Mode (Rated or Unrated)	N1 Command = f (Throttle)	FN = f (N1)
AutoThrust Mode	TPR Mode	N1 Command = f (N1 Target)	FN = f (TPR)
	N1 reversionary Mode (Rated or Unrated) Only if one engine in N1 unrated	N1 Command = f (N1 Target)	FN = f (N1)

ENGINE POWER PHILOSOPHY - COMMANDED THRUST AND ACUTE PARAMETER CALCULATION (SUMMARY)

THRUST CONTROL DESCRIPTION (3)

Air Data Selection Logic

Engine P0 and P20/T20 signals are sent by the EEC to the 3 independent Air Data Inertial Reference Units (ADIRUs) computers via the Aircraft AFDX network to be used as inputs to the air data selection logic.
Engine P0 is measured by a single transducer, which is situated in the EEC. The transducer measures the pressure P0 air pressure from Zone 1 as under-cowl pressure environment.
The Engine air data selection logic has the input of each of the three parameters (P0, P20 and T20) of the EEC compared with each of the three ADIRU parameters, which are:
-Ps (static pressure) equivalent to engine P0,
-Pt (total pressure) equivalent to engine P20,
-TAT (Total Air Temperature) equivalent to engine T20
The 3 ADIRUs plus the 4 EECs give a total of 7 available sources that are compared and validated through the AFDX network, to compute the TPR or N1 command.
To make sure that the engine thrust symmetry or N1 symmetry and the selection between the TPR and the N1 mode are related to the availability of air data inputs to the EEC.

TPR actual Calculation

TPR actual is derived from the P20, P30, T20 and TGT parameters.
P20/T20 probe is installed in the Engine air intake forward of the fan. The probe is electrically heated to prevent ice formation.
P30 (measure of the HP Compressor exit pressure) is used into the EEC to calculate the TPR and to schedule fuel to the burners.
14 Turbine Gas Temperature (TGT) thermocouples (low pressure turbine inlet temperature) supply a gas temperature measurement. This temperature measurement is also used to compute theTPR.
The value of TPR is calculated using the following relationship:
TPR=P30 EGT/P20 T20.

Reversionary Thrust Control

The Reversionary Thrust Control gives a backup control in the event that the FADEC System can no longer support theTPR control.
The reversionary thrust control mode has the following settings:
Rated reversionary thrust control, which is selected when there is not enough valid signals to calculate a TPR thrust setting demands.
Unrated reversionary thrust control, which is selected when there are not enough valid parameters available to calculate the TPR thrust setting demands.

Rated Reversion Thrust Control

Rated reversion is used when it is not possible to calculate an engine TPR actual, but theTPR command can still be derived and so rated N1 is derived from the TPR command.
The rated reversionary thrust control N1 command is calculated as the product of T20 and TPR command and calculated mach number.
The EEC selects rated reversionary thrust control when one or more of the following conditions are true:
1) TGT measurement has been confirmed as Invalid.
2) Selection of model P30 has been confirmed as Invalid.
3) P30 measurement has been confirmed as Invalid.
4) TPR measurement has been confirmed as Invalid.
5) TPR control loop upward run-away is detected.
6) P30 pipe fault detection has been confirmed.
7) P30 pipe freezing has been detected.

Unrated Reversion Thrust Control

The unrated reversionary thrust control N1 command is selected as the reversionary thrust control N1 command when it is not possible to calculate a TPR demand.
The unrated reversionary thrust control N1 command is scheduled as a function of TRA position and altitude.

The EEC selects unrated reversionary thrust control when one or more of the following conditions are true:
1) P0 signal has been confirmed as Invalid.
2) P20 signal has been confirmed as Invalid.
3) T20 signal has been confirmed as Invalid.

Autothrust Control

The AFS interfaces with the FADEC System to give an Autothrust function, including the Alpha Floor protection.
The Autothrust function can be engaged or disengaged according to the logic implemented in the PRIM computer. When engaged, the function is either active or inactive.
Once engaged and active, the EEC uses the airframe N1 target to set the engine power level. In normal mode, even if the A/THR sends an N1 target to the engine, the THR is computed from the TPR.
Autothrust is operative in the TPR and ALTerNate (N1) modes.
The Autothrust function can be engaged if the engines are not in the same mode (TPR or N1).
The PRIM accepts the engine in ALTerNate N1 Unrated mode.

Autothrust Function Engagement / Disengagement / Activation

The engagement of the Autothrust function can be accomplished manually or automatically in the Airframe.
The Autothrust function can be engaged manually through the A/THR push button of the FCU.
The Autothrust function is automatically engaged when throttles are set in the take off detent (it is associated to the engagement of the TAKE-OFF / GO AROUND mode of the autopilot) or when the Alpha Floor protection is activated.
The disengagement of the Autothrust function can be achieved:
Manually via the instinctive disconnect push buttons located on the Throttle Levers (normal operation):
- Manually through the FCU Autothrust push-button (if already engaged):
- Automatically when all (4) Throttle Levers are selected at Idle.
- Automatically when all (2) Thrust reverser levers are selected to Reverse.
- Automatically when more than 1 Engine is not in A/THR mode.
- Automatically in case of more than 1 Engine failure.
- Automatically in case of failure seen by the AFS.

In case of Autothrust disengagement, each Engine is controlled in manual mode, or in memo mode in the case of involuntary disconnection.
When Autothrust is engaged it can be:
- Active: throttle levers between IDLE and CLB (or MCT with one Engine failure) and at least one throttle at or below CLB (with no Engine failure). Thrust is controlled by the A/THR function.
- Inactive: if all throttles are above CLB (or above MCT with one Engine failure). Thrust is controlled by the throttle position.

ALPHA FLOOR: Autothrust Activation

In case of Alpha FLOOR detection the A/THR mode is automatically activated and commands the TOGA thrust, regardless of the throttle lever position.

Cockpit Thrust Display (ACUTE)

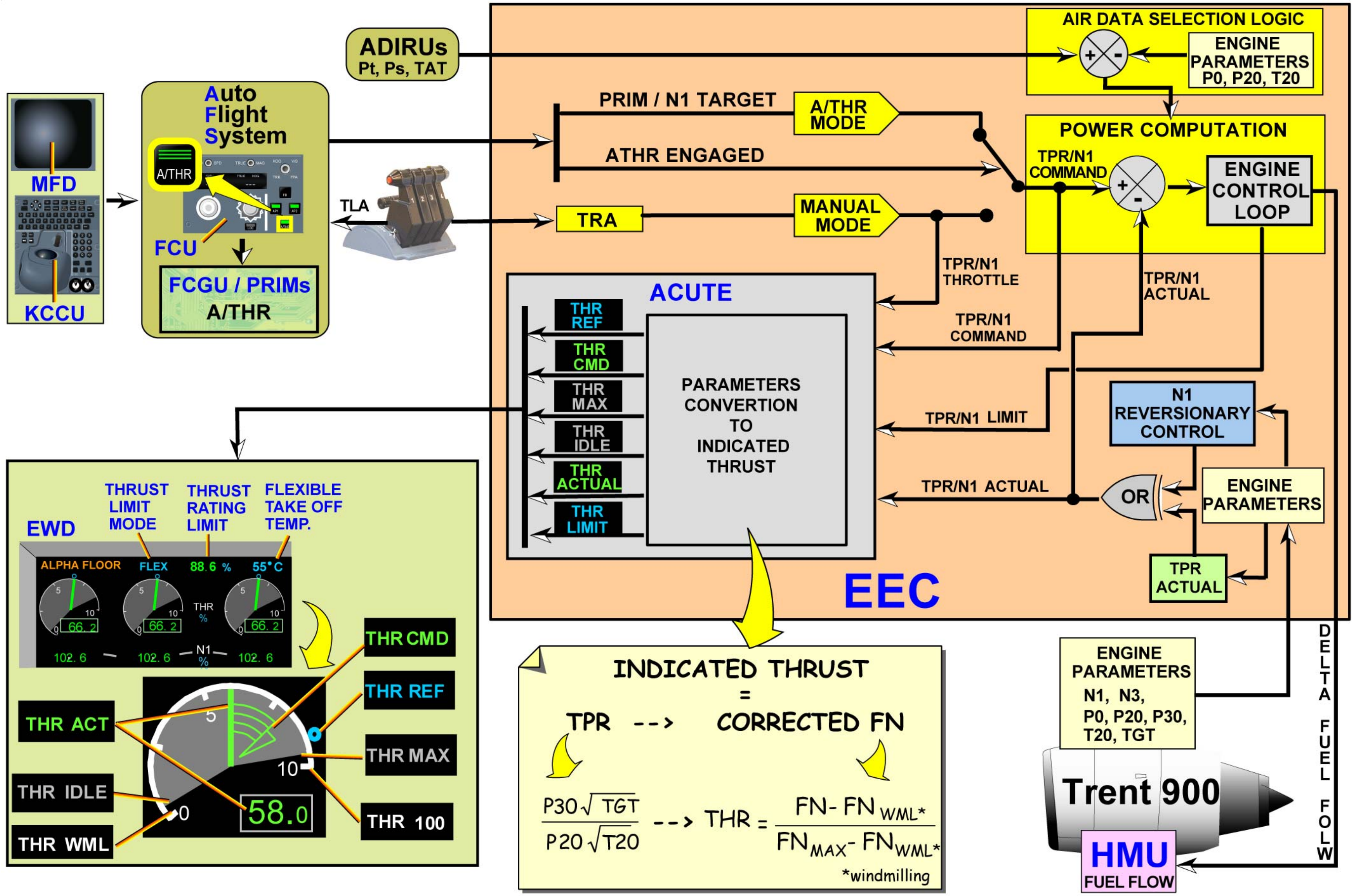
ACUTE (AIRBUS Cockpit Universal Thrust Emulator) is a percentage indication of thrust.
The ACUTE function calculates percentage parameters from engine command and thrust feedback parameters, for transmission to the airframe and subsequent cockpit display.
The parameters are:
- THR Limit,
- THR Actual,
- THR Command,
- THR REF (Throttle),

- THR Idle,
- THR Max.

THR WML: Thrust windmilling is the THR achieved when engine in Wind Milling (0%).
THR 100: Thrust 100 is the THR achieved when Throttle at TOGA and Bleed Off (100%).
THR IDLE: Low-end of grey sector, corresponds to the THR achieved when the engine is operating at Idle.
THR MAX: High-end of grey sector agrees with the THR achieved when throttle at TOGA detent.
THR Actual: The value of THR ACT is calculated using the following relationship: FN ACT - FN WML / FN 100 - FN WML.
The parameters THR100, THR Limit, THR Actual, THR Command, THR Throttle, THR Idle, THR MAX, are sent to the airframe CDS through the AFDX network.
When operating in Unrated N1 mode the EEC THR parameters output sent to the airframe CDS are not computed.

Thrust Limit Modes and Thrust Limit Values

The thrust limit mode (Max CLB, Derated Climb, Derated Take-Off, FLEXible take off, MTO, MCT, GA, FlexGA), is calculated to show the engine thrust setting mode from which the thrust Limit (THR LIMIT) value is computed. The selected thrust limit mode is shown in the cockpit beside the thrust limit value.
THR Limit value is a calculated value derived from TPR mode.
THR Limit value in N1 mode is the value of THR Limit calculated as derived for N1 mode.



AIR DATA SELECTION LOGIC ... COCKPIT THRUST DISPLAY (ACUTE)

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ENGINE START / CRANK CONTROL DESCRIPTION (3)

Ignition and Starting System Description

The ignition and starting system has three subsystems:
- Starting,
- Fuel command,
- Ignition.

Starting

Engines can be started using the APU air bleed, a ground air supply or crossbleed air from an operating engine.
The Engine Electronic Controller (EEC) controls the opening and closing of the Starter Air Valve (SAV) in all start modes. The SAV controls the air flow to the pneumatic starter. The Pneumatic starter drives N3 through the accessory gearbox.
The starter has three different cycles:
Normal cycle runs:
- Up to 2 minutes continuous operation then runs down to zero N3,
- Up to 2 minutes continuous operation then runs down to zero N3,
- Up to 1 minute continuous operation then runs down to zero N3 and wait 30 minutes for the cooling.

Extended start cycle:
- Up to 5 minutes continuous operation followed by 30 minutes wait for the cooling.

Extended crank cycle:
- Up to 5 minutes continuous operation followed by 30 minutes wait for the cooling.

Fuel command

The EEC controls, through the Metering Valve (MV) servovalve, the Fuel Metering Valve (FMV) which regulates the fuel flow to the manifolds.
The ENGine MASTER lever controls, through the airframe shutdown solenoid, the closing of the High Pressure Shut-OFF Valve (HP SOV).
The HPSOV is also called the Minimum Pressure Shut-Off Valve (MP SOV).
EEC controls through the protection motor the closing of the HPSOV.
The Fuel Flow Transmitter (FF XMTR) sends his data to the EEC.

Ignition units power supply

The Engine Interface Power Management (EIPM) supplies ignition units (A and B) through the EEC (channel A and B) control.
A/C BUS BAR 115 VAC EMERgency supplies EIPM ignitor A function.
EIPM Ignitor A function could supply Ignition unit A or B depending on the EEC switching.
A/C BUS BAR 115 VAC NORMal supplies EIPM ignitor B function.
EIPM Ignitor B function could supply Ignition unit A or B depending on the EEC switching.

EEC ignition units switching function:

Each EEC channel is able to control the switching of the power supply of the two ignition units A and B.
During an engine auto start on ground, the EEC controls automatically the switching of the ignition units A or B.
During an engine manual start, the EEC controls both ignition units A and B, for ignition efficiency.
Note: During Engine auto start in flight, both ignition units are energized, for redundancy.

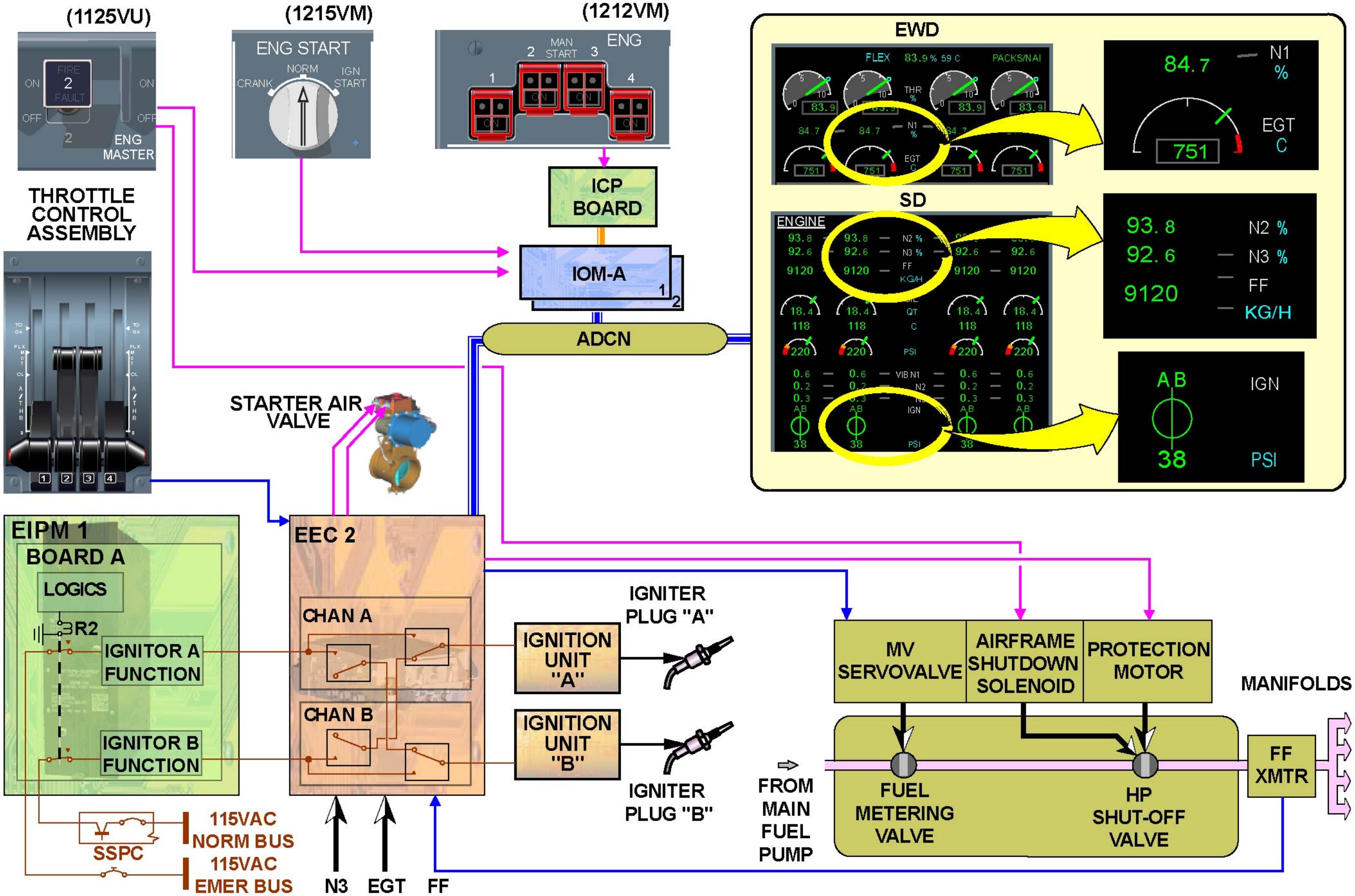
Controls from the cockpit

The engine start/crank is controlled from the cockpit by:
- ENGine rotary selector,
- ENGine MASTER levers,
- ENGine MANual START P/B SW,
- Throttle Control Assembly (TCA).

System functions

The engine can be started in two manners:
- Automatic start (normal procedure),

-Manual start (back-up procedure).
The engine can be cranked in two manners:
- Dry crank,
- Wet crank.
Continuous relight function:
-Manually selected with ENG START rotary selector to the "IGN/START" position.
Auto-relight function:
- When a flame-out is detected the system energizes the two igniters.
Quick relight function (in flight only):
- When the ENG MASTER lever is inadvertently selected "OFF", the ENG MASTER lever can be selected "ON" again within 30 seconds to cancel the shutdown sequence.



IGNITION AND STARTING SYSTEM DESCRIPTION

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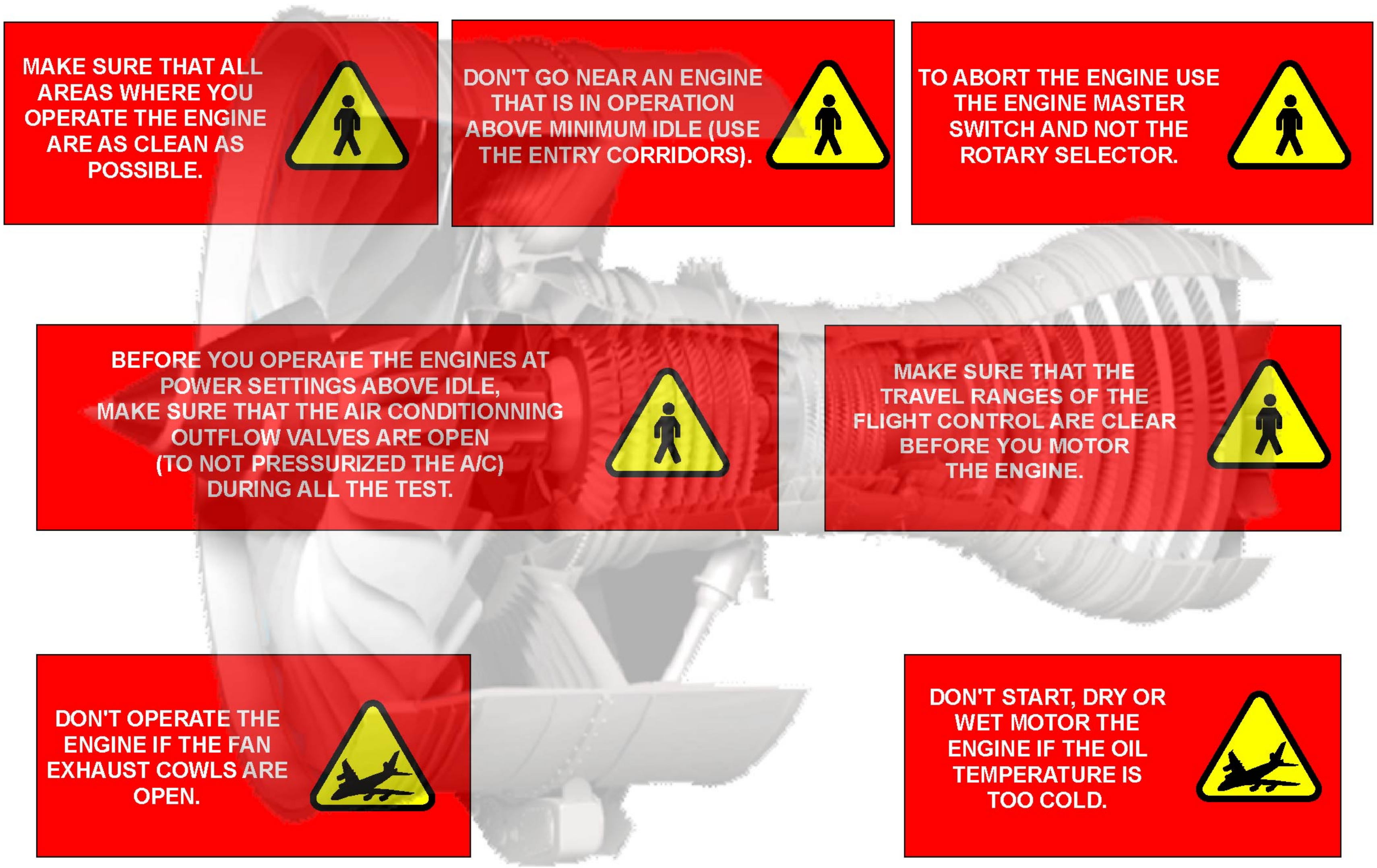
ENGINE START / CRANK CONTROL DESCRIPTION (3)

Instructions and Precautions For Engine Ground Operation

WARNING: -YOU MUST NOT GO NEAR AN ENGINE THAT IS IN OPERATION ABOVE MINIMUM IDLE. IF YOU DO, IT CAN CAUSE AN INJURY. WHEN AN ENGINE IS IN OPERATION AT MINIMUM IDLE, YOU CAN ONLY GO NEAR IT THROUGH THE ENTRY CORRIDORS.
-YOU MUST MAKE SURE THAT ALL AREAS WHERE YOU OPERATE THE ENGINE ARE AS CLEAN AS POSSIBLE. ALL AREAS MUST BE VERY CLEAN TO PREVENT INJURY AND SERIOUS DAMAGE TO THE ENGINE AND AIRCRAFT.
-BEFORE YOU OPERATE THE ENGINES AT POWER SETTINGS ABOVE IDLE, MAKE SURE THAT THERE IS NO RISK OF PRE-PRESSURIZATION OR RESIDUAL PRESSURE IN THE AIRCRAFT AFTER SUBSEQUENT ENGINE SHUTDOWN. TO DO THIS, MAKE SURE THAT THE AIR CONDITIONING OUTFLOW VALVES ARE OPEN DURING THE ENTIRE TEST.
-IF PERSONS TRY TO OPEN A DOOR WHEN THERE IS RESIDUAL PRESSURE IN THE AIRCRAFT:
-THE DOOR CAN OPEN WITH DANGEROUS SUDDEN FORCE,
-THERE IS A RISK OF BAD INJURY OR DEATH, AND
-THERE CAN BE DAMAGE TO THE AIRCRAFT.
-MAKE SURE THAT THE TRAVEL RANGES OF THE FLIGHT CONTROL SURFACES ARE CLEAR BEFORE YOU MOTOR THE ENGINE. MOVEMENT OF THE FLIGHT CONTROL SURFACES CAN BE DANGEROUS AND/OR CAUSE DAMAGE.
-TO ABORT THE ENGINE START SEQUENCE, YOU MUST PUT THE ENG/MASTER SWITCH BACK TO THE OFF POSITION. IF YOU ONLY CHANGE THE POSITION OF THE ENGINE MODE ROTARY SELECTOR SWITCH (FROM IGN/START TO NORM), THE FADEC SYSTEM WILL NOT ABORT THE START SEQUENCE. THIS CAUSES A RISK THAT THE ENGINE WILL CONTINUE TO START. THIS, IN TURN, CAN CAUSE INJURIES TO PERSONNEL.

CAUTION: -YOU MUST NO OPERATE THE ENGINE IF THE FAN EXHAUST COWLS ARE OPEN. IF THE ENGINE IS OPERATED WHEN THE FAN EXHAUST COWLS ARE OPEN, DAMAGE TO THE POWER PLANT CAN OCCUR.
-YOU MUST NOT START, DRY MOTOR OR WET MOTOR THE ENGINE IF THE OIL TEMPERATURE IS TOO COLD (REFER TO AMM). LOW OIL TEMPERATURES CAN CAUSE DAMAGE TO THE ENGINE BEARINGS.
-IF THE ENGINE IS IN COLD ENVIRONMENT, THE ENGINE OIL CAN BECOME TOO COLD. IF THE ENGINE IS NOT OPERATED, AND IS IN THIS ENVIRONMENT, YOU MUST DO A CHECK OF THE ENGINE OIL TEMPERATURE REGULARY. IF NECESSARY, DO AN ENGINE START AND OPERATE THE ENGINE AT IDLE UNTIL THE ENGINE OIL TEMPERATURE IS SATISFACTORY.



INSTRUCTIONS AND PRECAUTIONS FOR ENGINE GROUND OPERATION

ENGINE START / CRANK CONTROL DESCRIPTION (3)

Automatic Start

The automatic start sequence could be automatically or manually aborted.

Automatic Start on Ground

The procedure to start the engine in automatic mode
Initial configuration of controls (engine not running) is:
The ENG MASTER lever is set to the "OFF" position and the ENG START rotary selector is set to the "NORM" position.
Set the ENG START rotary selector to the "IGN/START" position.
The ECAM ENGINE page is displayed and the Air Generation Unit (AGU) flow control valves close.
Set the ENG MASTER LEVER to the "ON" position. The Low Pressure (LP) fuel valve opens and the SAV opens.
When N3 reaches 25% and the Exhaust Gas Temperature (EGT) is below 150°C, the following events occur:
- The ignition is in function on the igniter A or B,
- The HP SOV opens,
- The FF increases,
- The EGT increases.

Note: The maximum EGT during a start is 700°C.
When N3 reaches 50%, the SAV closes, the igniters cuts off and the AGU flow control valves reopen if there is no other engine in starting sequence.
Note: The maximum of EGT during a start is 700°C.
Set the ENG START rotary selector to the "NORM" position. The ECAM ENGINE page disappears.
If after engine start, the rotary selector is set to NORM and back to IGN/START, continuous relight is activated on the running engine(s).

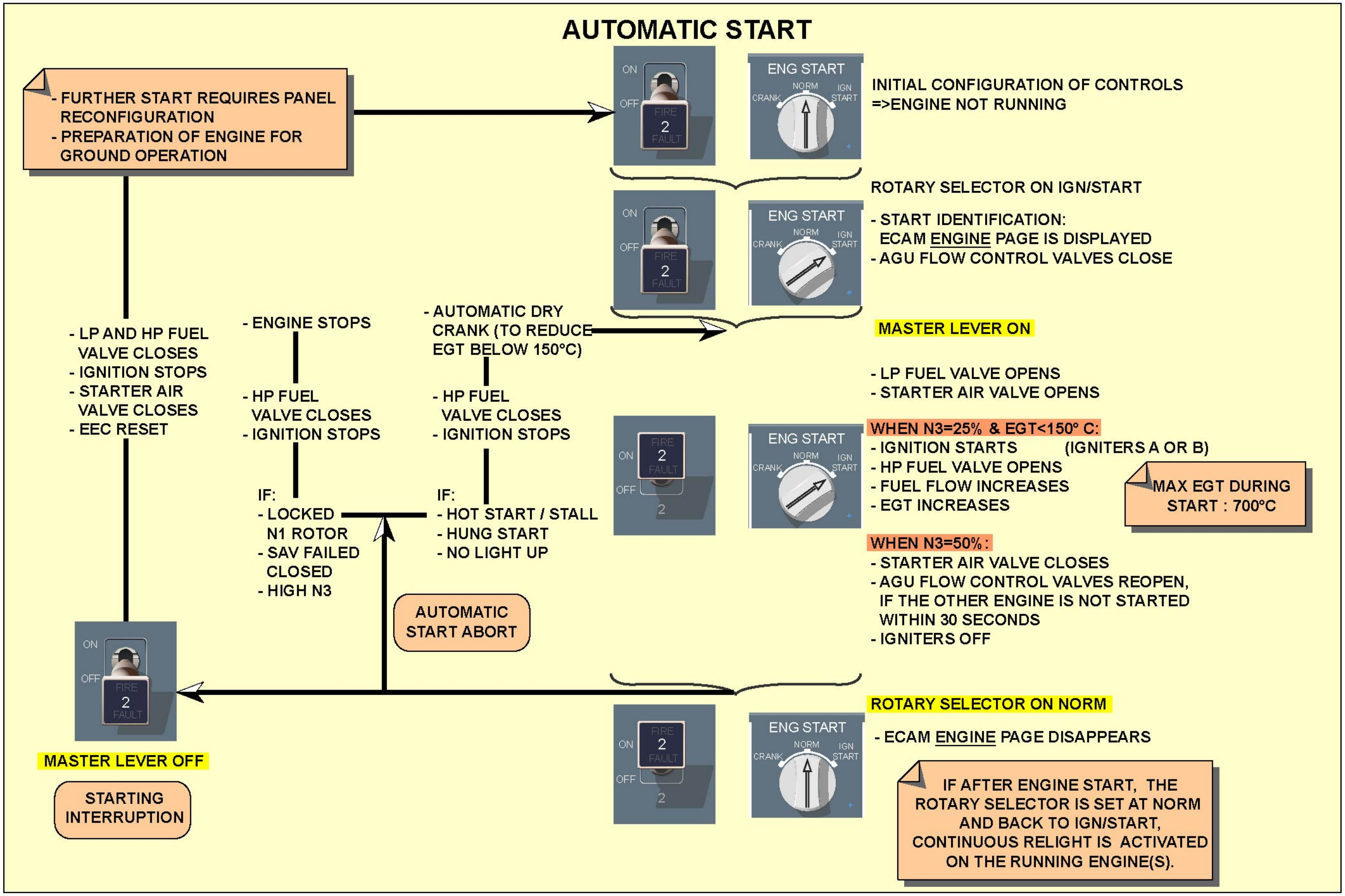
Automatic Start Abort

Automatic start abort is initiated when the following troubles occur:
- Hot start / stall
- Hung start,
- No light up,
- Locked N1 rotor,
- SAV failed closed,
- High N3.

If there is a default, the HP SOV automatically closes and the ignition stops.
If there is hot start /stall, hung start or no light up, the EEC automatically initiates a shutdown followed by a dry cranking period (to reduce EGT below 150°C) and then the EEC tries a new start.
If there is a N1 rotor locked, a SAV failed closed or too high N3, the engine start is automatically aborted.

Automatic Start Manual Abort

If a default occurs you can at anytime SET the ENG MASTER lever to the "OFF" position.
ENG MASTER lever set to the "OFF" position has priority over the automatic mode. At this time the HP and LP SOVs closes, the ignition stops, the SAV closes and the EEC is reset.
To restart the engine, proceed to another automatic start.



AUTOMATIC START - AUTOMATIC START ON GROUND ... AUTOMATIC START MANUAL ABORT

ENGINE START / CRANK CONTROL DESCRIPTION (3)

Manual Start

The manual start sequence could be aborted only manually

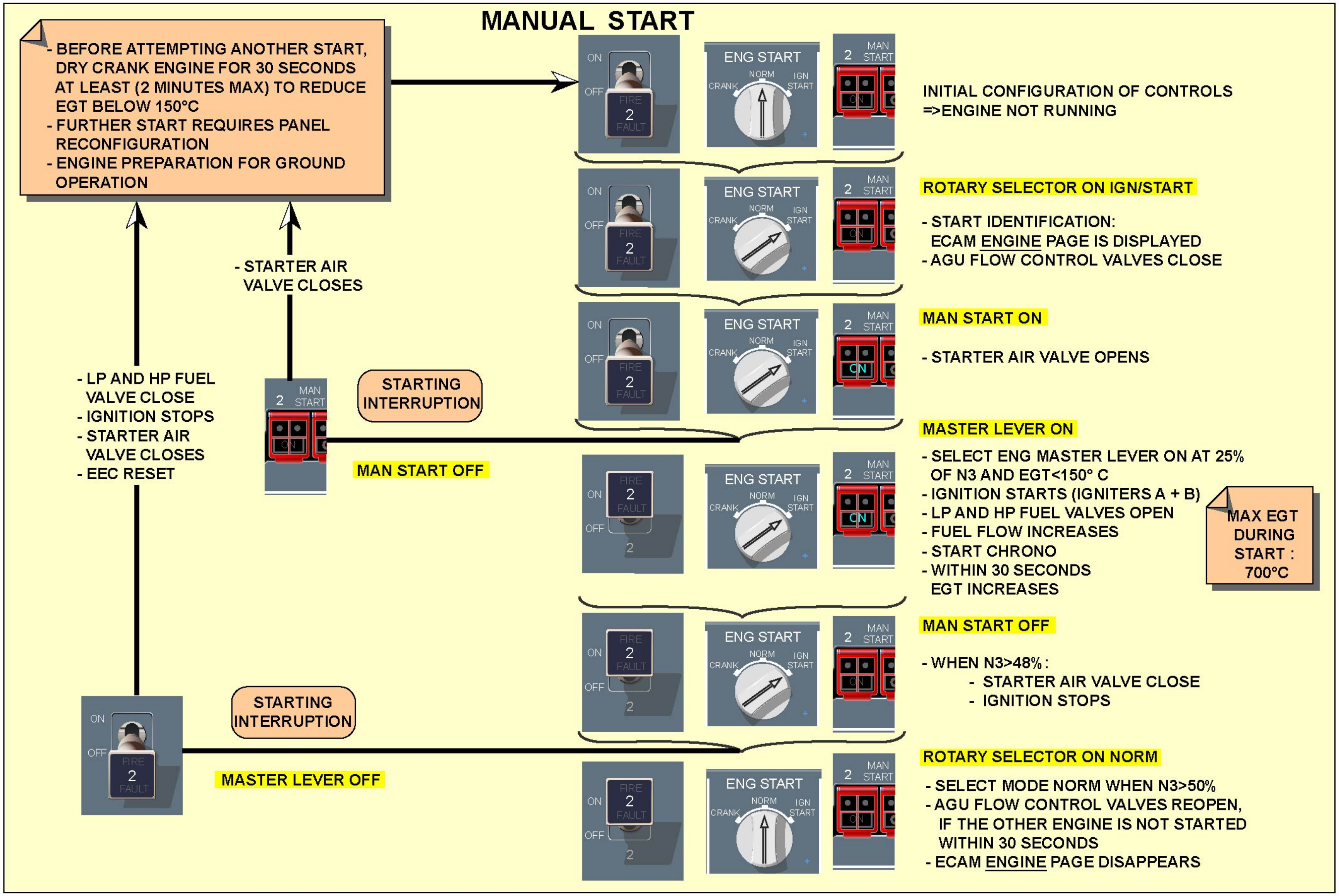
Manual Start on Ground

The procedure to start the engine in manual mode.
Initial configuration of controls (engine not running) is:
The ENG MASTER lever is set to the "OFF" position, the ENG START rotary selector is set to the "NORM" position and the ENG MAN START P/B SW "ON" legend lights off.
Set the ENG START rotary selector to the "IGN/START" position. The ECAM ENGINE page is displayed and AGU flow control valve closes.
Set the ENG MAN START to the "ON" position. The SAV opens.
When N3 reaches 25% and the Exhaust Gas Temperature (EGT) is below 150°C, set the ENG MASTER lever to the "ON" position. The following events occur:
- The ignition starts on the igniter A and B,
- The LP fuel valve and the HP SOV open,
- The FF increases,
Start the chronometer:
- Within 30 seconds, the EGT increases.
Note: The maximum EGT during a start is 700°C.
When N3 reaches 48%, set the ENG MAN START to the "OFF" position. The following events occur:
- SAV closes,
-Ignition stops.
When N3 reaches 50%, set the ENG START rotary selector to the "NORM" position, this actions occurs:
- AGU flow control valves reopen if there is no other engine in starting sequence,
- The ECAM ENGINE page disappears.

If after engine start, the rotary selector is set to NORM and back to IGN/START, continuous relight is activated (on the running engine)

Manual Start Interruption

Before to set the ENG MASTER lever to the "ON" position, you can interrupt the start sequence by setting the ENG MAN START P/B SW to the OFF position. This action causes the closing of SAV.
If, a SAV failed closed, a locked N1 or a too high N3 is detected you must set the ENG MAN START P/B SW to the "OFF" position.
After you set the ENG MASTER lever to the 'ON" position, you can interrupt the engine starting by setting the ENG MASTER lever to the "OFF" position. Following to this action, the LP fuel valve and the HP SOV close, the ignition stops, the SAV closes, and the EEC is reset.
The ENG MASTER lever must be set to the "OFF" position, when the following troubles occurs:
- Hot start / stall
- Hung start,
- No light up,
- Locked N1 rotor,
- SAV failed closed,
- High N3.
Before attempting another start, dry crank the engine for 30 seconds at least (2 minutes max) to reduce EGT below 150°C.



MANUAL START - MANUAL START ON GROUND & MANUAL START INTERRUPTION

ENGINE START / CRANK CONTROL DESCRIPTION (3)

Cranking

Dry crank or wet crank can be done.

Dry Crank

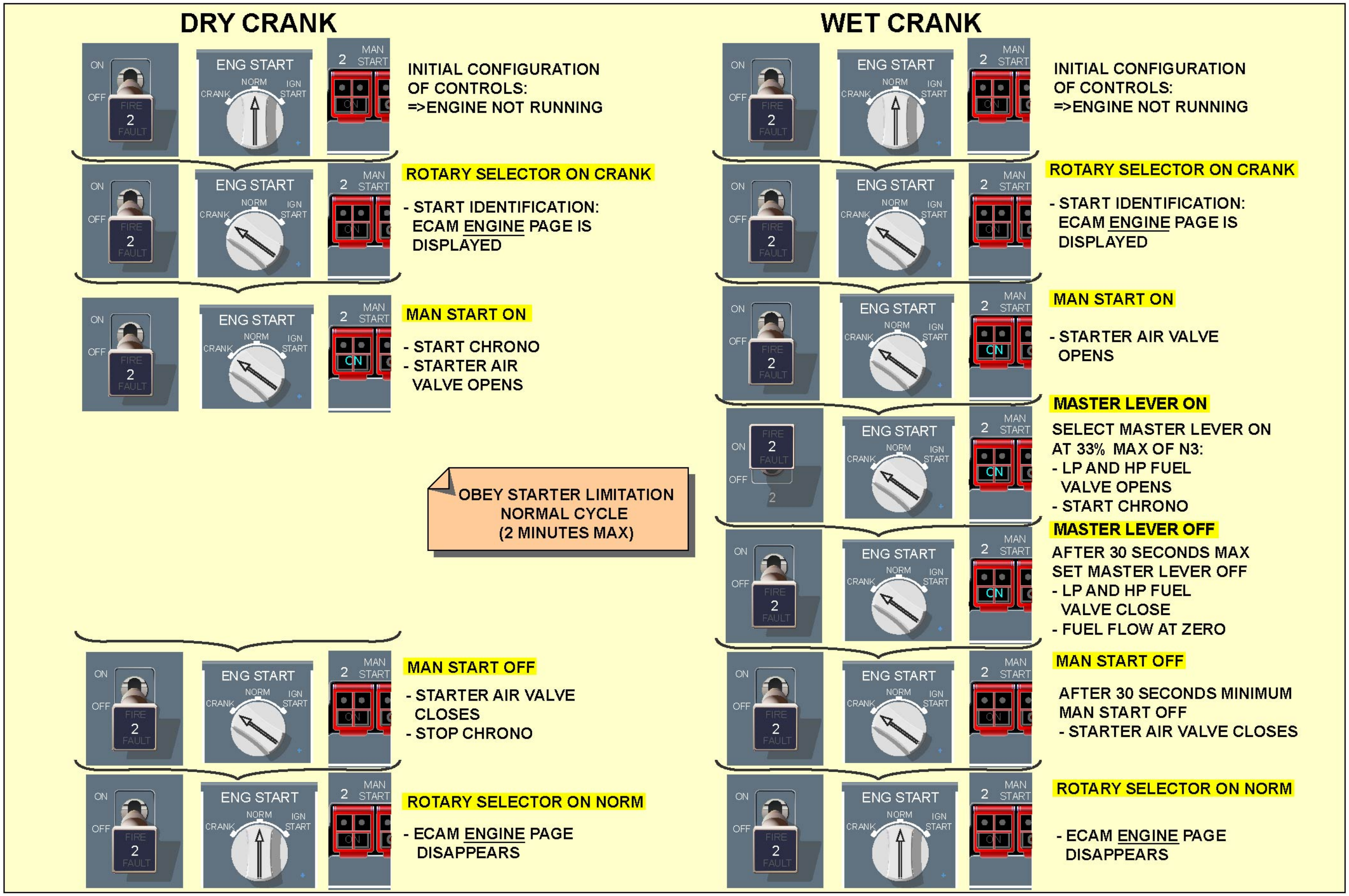
Dry crank is used to remove any residual fuel from the combustion chamber and to check if there is not oil leak.
During Initial configuration of controls (engine not running):
The ENG MASTER lever is set to the "OFF" position, the ENG START rotary selector is set to the "NORM" position and the ENG MAN START P/B SW "ON" legend lights off.
Set the ENG START rotary selector to the "CRANK" position. The ECAM ENGINE page is displayed.
Set the ENG MAN START to the "ON" position. The SAV opens.
Start the chronometer.
Note: Dry crank the engine from 30 seconds untill 2 minutes maximum.
Set the ENG MAN START to the "OFF" position, SAV closes,
Stop the chronometer.
Set the ENG START rotary selector to the "NORM" position, the ECAM ENGINE page disappears.

Wet Crank

Wet crank is used to check if there is not fuel leaks.
The Initial configuration of controls (engine is not running) is:
The ENG MASTER LEVER set to the "OFF" position, the ENG START rotary selector set to the "NORM" position and the ENG MAN START P/B SW "ON" legend lights off.

NOTE: Note: obey the starter limitation (normal cycle : 2 minutes maximum)

Set the ENG START rotary selector to the "CRANK" position, the ECAM ENGINE page is displayed.
Set the ENG MAN START to the "ON" position, the SAV opens.
When N3 reaches 33%, set the ENG MASTER lever to the "ON" position, LP fuel valve and the HP SOV open, then start the chronometer.
After 30 seconds set the ENG MASTER lever to the "OFF" position, and the following events occur:
-LP and the HP fuel valves close (Make sure that the FF is at zero).
After 30 seconds set the ENG MAN START to the "OFF" position, this causes the closing of the SAV.
Set the ENG START rotary selector to the "NORM" position, the ECAM ENGINE page disappears.



CRANKING - DRY CRANK & WET CRANK

THRUST REVERSER CONTROL DESCRIPTION (3)

General

The A380-800 Trent 900 Electrical Thrust Reverser Actuation System (ETRAS) is an electro-mechanical system which allows the translating cowls of the engine 2 & 3 to be deployed and stowed in response to electrical commands from the EEC and from the aircraft interfaces.
The thrust reverser assembly is installed at the aft part of the nacelle, only on the aircraft inboard engines (No. 2 & 3).
The assembly is a conventional fixed cascade translating cowl blocker door type. It is made of two halves that make a duct around the engine.
Each halve has a fixed structure, which is used as a support for the cascades, the actuation system and the translating cowl.
Both engine-translating cowls are mechanically linked and slid onto the thrust reverser upper and lower tracks.
The Thrust Reverser halves open at the 12 o'clock hinge beam to give access to the engine during maintenance operations.
The ETRAS carries out the following functions:
- deployment of the thrust reverser translating cowls when the deploy command is set,
- stowage of the thrust reverser translating cowls when the stow command is set,
- avoidance of inadvertent deployment of the thrust reversers,
- manual deployment and stowage of the translating cowls for maintenance,
- manual inhibition and deactivation of the translating cowls for maintenance.

Architecture

The Deploy command has three independent electrical command lines upon a reverser thrust selection on the throttle control assembly:
- an aircraft 115 VAC power supply commanded by the flight/ground control PRIM to the tertiary lock system,
- an aircraft 155 VAC from EIPM to TRPU,
- an electrical command from EEC to ETRAC.
For ETRAS monitoring, fault reporting and BITE test, the EEC communicates with the On-board Maintenance System (OMS) and Control and Display System (CDS) via ADCN.
For maintenance equipments, a thrust reverser operational test (deploy/stow) is available on the OMS.
The ETRAS is basically composed of:
- Electronic Thrust Reverser Actuation Controller (ETRAC),
- Thrust Reverser Power Unit (TRPU),
- Power Drive Unit (PDU) electrical motor,
- 6 ball screw actuators mechanically driven through a synchronizing flexible shaft power train system from the PDU.

Actuation

The Electrical Thrust Reverser Actuation System (ETRAS) operates in normal mode, when the following initial conditions are met:
- aircraft on the ground,
- engines are running,
- and Throttle Lever in Reverse thrust position.
The Electrical Power is supplied from the aircraft to the TRPU.
The TRPU supplies electrical power through the ETRAC to all the electrical components.
The ETRAC releases all the locks and the PDU brake.
Electrical power is transformed into mechanical power by the PDU.
The PDU is composed of:
- a motor and a resolver assembly,
- a brake assembly.
The disc brake of the PDU needs to be energized for release.
When the brake solenoid is de-energized, the disc brake engages:
- to maintain preload of actuation system in fully stowed position,
- to lock the T/R in fully deployed position.
The electrical motor of the PDU gives torque and rotational speed to the flexible shafts,

-Mechanical power is then distributed to middle ball-screw actuators by 2 flexible shafts.
-Mechanical power is distributed to the other 4 actuators by flexible shafts.
Middle actuators have a Manual Drive Unit (MDU) which allows the manual deployment / stowage for maintenance operations.
There are two primary locks, one on the top right actuator and one on the top left actuator.
These internal locks are part of retention means of the thrust reverser system. Their function is to lock the thrust reverser when stowed.
Two resolver sensors mounted on the lower actuators monitor the position of the translating cowls.
The EEC detects that:
- the upper translating actuators (LHS and RHS) are locked, through the two primary lock system proximity sensors.
- the translating cowls are in the stowed position through the lower actuator position cowl resolvers.
The ETRAC implements the ETRAS control functions except for tertiary lock.
The ETRAC commands the left PLS to unlock for deployment, and through the TRPU:
-the right PLS and the disc brake to unlock for deployment,
-the disc brake to engage at the end of the deploy sequence, to secure the T/R in fully deployed position,
-the disc brake to unlock for stowing,
-the electrical motor of the PDU for deployment or stowing,
- provides monitoring data to the EEC, including ETRAS BITE results, data of the TRPU internal power switch.
The Tertiary Lock System (TLS) is installed on the nacelle structure at the rear bottom of the left translating cowl.
The function of the TLS is to lock the thrust reverser when it is stowed, in order to prevent an inadvertent deployment, mainly in flight.
The TLS design follows a fail-safe motion in which the TLS engages into a locked position when the electrical power is removed.
The Tertiary Lock System (TLS) is mechanically locked.
The Tertiary Lock System must be electrically released to allow deployment.
Two proximity sensors are mounted on this Tertiary Lock System.
The EEC detects that the TLS is locked or unlocked through the two TLS proximity sensors.

First Defense Line

When The EEC detects that the aircraft is on the ground (LGERS discrete signal) and Throttle Reverser Angle (TRA) thresholds are reached (-9 for deploy signal and -8 for stow signal), the EEC sends to the Electronic Thrust Reverser Actuation Controller (ETRAC) deploy/stow order for thrust reverser operation.

Second Defense Line

Actuating as the second line of defense of the ETRAS:
- The Engine Interface Power Management (EIPM) will control the switching of low power supply (28 VDC) to the ETRAC for basic control of the thrust reverser system in normal operation and during maintenance operation when the aircraft is on the ground (LGERS discrete signal).
- The EIPM controls and monitors the switching of the 115 VAC 3 phases power supply to the TRPU.

Third Defense Line

The PRIMary flight control and guidance computer (PRIM) installed in the avionic bay will control the switching of the Solid State Power Controller (SSPC) providing the third line of defense of the ETRAS system.
The 115 VAC power supply for the Tertiary Lock System will be transformed and rectified into DC voltage through a TLS filter box.
The thrust reverser tertiary lock is the third line of defense to avoid an inadvertent deployment in flight. It stops the mobile structure in case of failure of the primary locks.
The tertiary lock is composed of one electro-mechanical lock, installed on the left 6 o'clock beam.

The tertiary lock can be manually deactivated in the unlock position to manually deploy the sleeves to get access to the cascades.
Two proximity sensors send the TLS position to the EEC.

Thrust Reverser Operation

Deploy Sequence

The two translating cowls are initially stowed.
The EEC detects that:
- the upper translating actuators (LHS and RHS) are locked through the proximity sensor signals of the Primary Lock System (PLS).
- the translating cowls are in the stowed position through the translating cowl resolver signals.

The deploy command is set.
The third defense line closes alternative current contactor and energizes the TLS once the Throttle Resolver Angle (TRA) is detected below the 4.5 degrees position.
The Engine Interface Power Management (EIPM) will command the 115 VAC (3 phases) power supply at the Thrust Reverser Power Unit (TRPU) input once the TRA is detected below the - 7 degrees position and ETRAC is supplied with 28 VDC.
The EEC confirms that the TLS is released through the TLS sensor A & B signals.
The deploy command will be sent by the EEC to the ETRAC through ARINC 429 bus.
The EEC will apply an hysteresis of 0.9 degrees on the throttle position: the throttle deploy condition will be true when the selected TRA is below - 9.0 degrees and will remain true until the selected TRA goes above - 8.1 degrees.
The engine throttle lever moves to a position below - 9.0 degrees.
The TRPU is distributing the electrical power to all the electrical components through ETRAC, which commands locks and the brake to be released. The Power Drive Unit (PDU) transforms the electrical power into mechanical power.
The mechanical power is distributed to:
- the two middle ballscrew actuators by two synchro flex shafts.
- the upper and lower actuators by four other flex shafts and allow the translating cowl to move in the deployment position.

The EEC detects that:
- the PLS are unlocked through the PLS unlock proximity sensor signals.
- the translating cowls are no more in the stowed position through left and right translating cowl resolvers signals.

The time for both translating cowls to deploy is monitored.
When both translating cowls reach 80 % of the full stroke, the EEC detects that the thrust reverser is fully deployed through left and right translating cowl resolvers signals.
Near full deploy position; the speed is reduced to slow.
When 100 % of the stroke is reached, the end actuator hard stop is engaged.
The motors stall at low speed and force limit. The ETRAC de-energizes lock drivers, brake drivers and disables inverter.
The aircraft opens alternative current contactor and may de-energize the Tertiary Locking System.

Stow Sequence

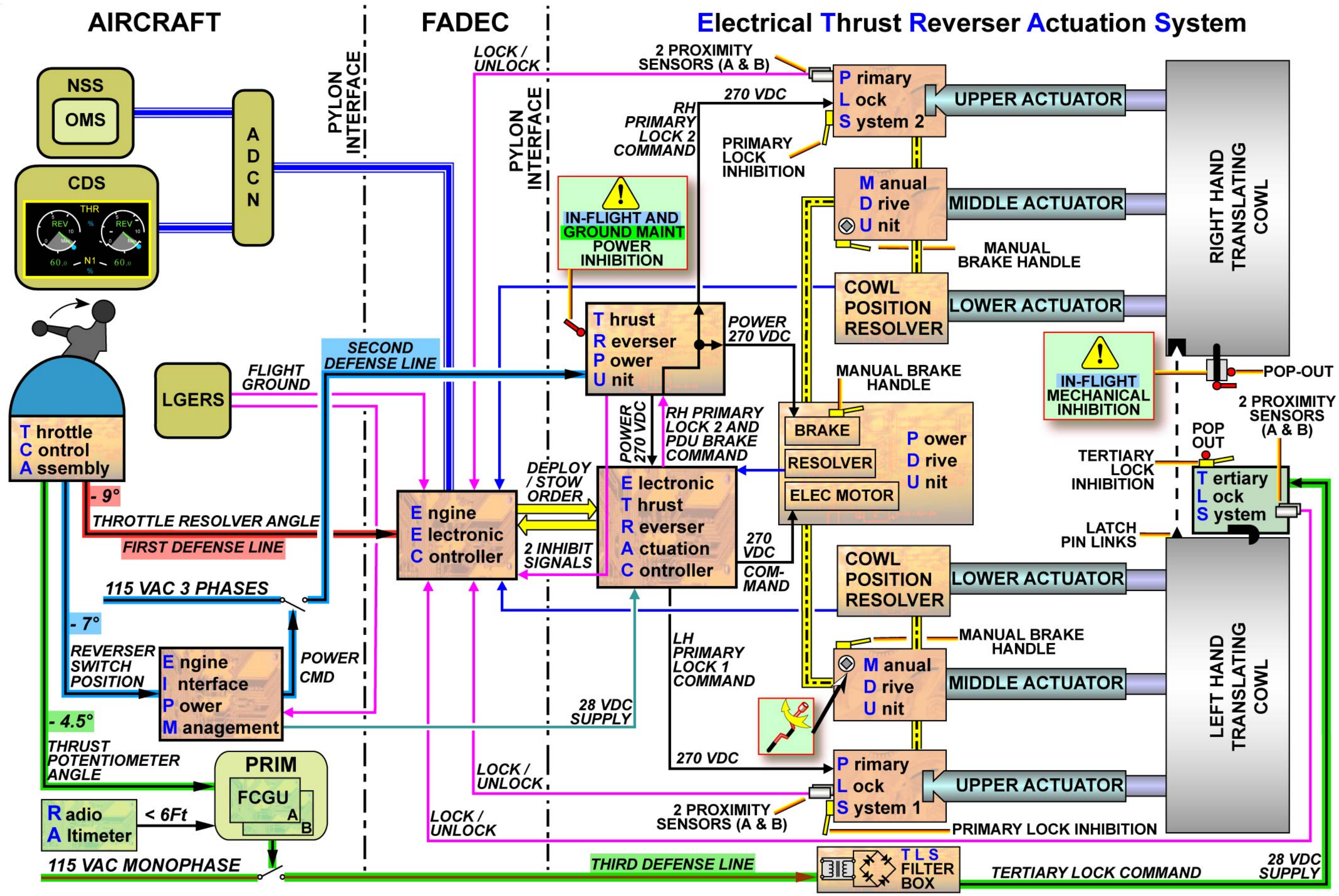
When the Aircraft is on the ground and a deploy command has previously been executed, or partially executed, the pilot selecting forward thrust will cause the EEC to initiate a stow command. The EEC will send the stow command to the ETRAC via the data bus which will then release the brake and command the motor to rotate in the opposite direction drawing the sleeves to close. The stow command will be transmitted continuously by the EEC to the ETRAC until the EEC detects the thrust reverser to be fully stowed.
The STOW sequence follows different steps:
The system is initially in the deployed position.
The engine throttle lever moves to the forward position and above - 8 degrees.
The EEC detects the TRA position above - 8 degrees.

The stow command sent by the EEC to the ETRAC through ARINC 429 bus.
The aircraft closes alternative current contactors and energizes the TLS once the TRA is detected up to - 4.5 degrees position.
The TRPU supplies the electrical power to all electrical components through the ETRAC, which commands the locks and brake to be released. The electrical power is transformed into mechanical power by the PDU.
The mechanical power is supplied to:
- the two middle ballscrew actuators by the two synchro flex shafts.
- the upper and lower actuators by four other flex shafts and let the translating cowl move in the stowage position.

The EEC detects that:
- the PLS are unlocked through the PLS unlock proximity sensor signals.
- the translating cowls are no more in the deployed position through left and right translating cowl resolver signals.

The translating cowls reach the position at which the tertiary lock is mechanically locked.
The EEC detects that:
- the TLS is locked through the TLS sensor signals.
- the PLS are locked through the PLS unlock proximity sensor signals.
- the translating cowls are in the stow position through the left and right translating cowl resolvers signal.
- the thrust reverser is stowed and locked.

The EIPM switches off the 115 VAC (3 phases) power supply at the TRPU input at the end of the stow sequence when the EEC indicates that
the thrust reversers are locked with a confirmation of 1 second.
The ETRAC 28 VDC will be isolated by the EIPM.



GENERAL ... THRUST REVERSER OPERATION

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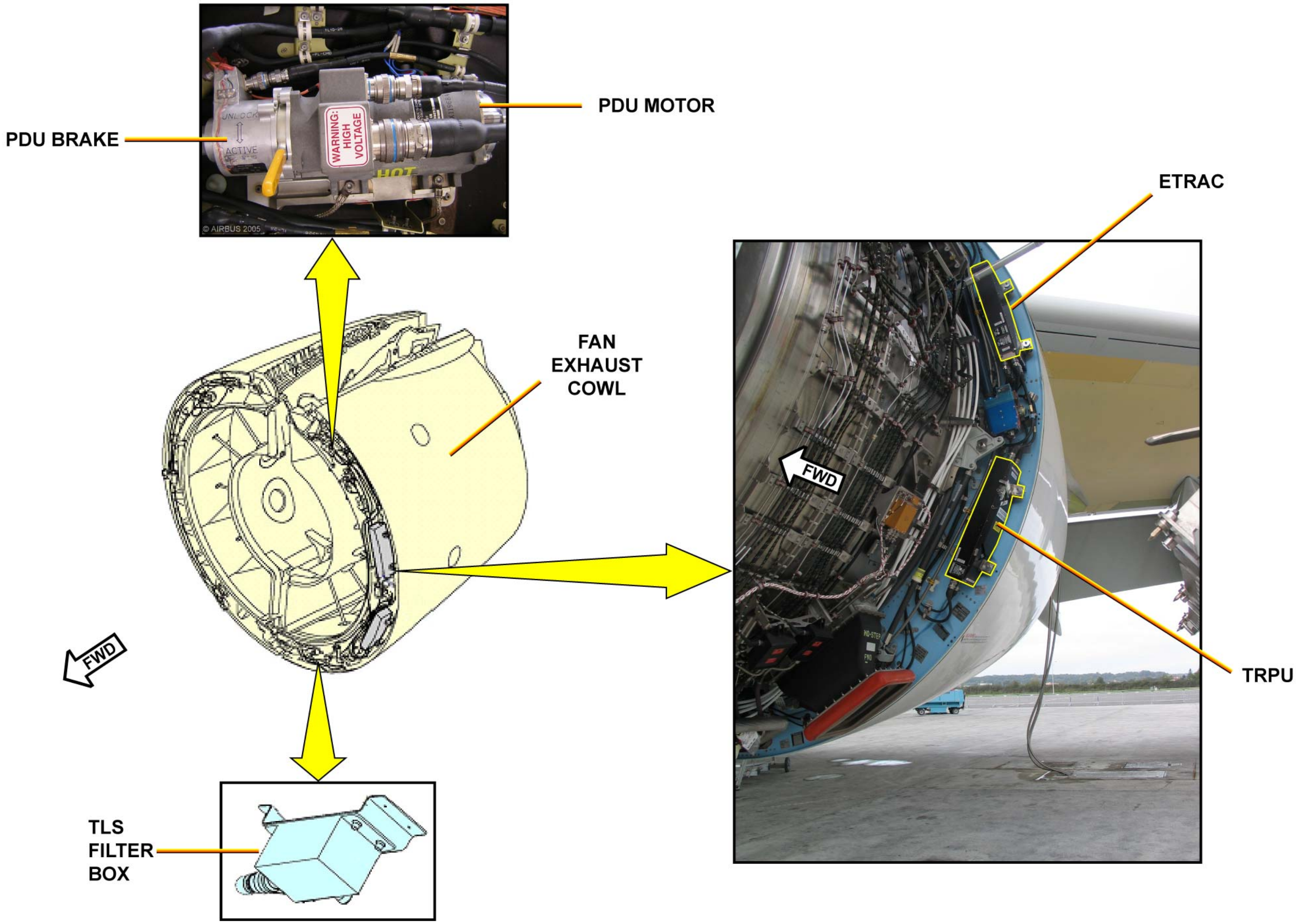
THRUST REVERSER CONTROL DESCRIPTION (3)

Major Component Identification

The major components of the ETRAS are installed on the forward frame of the Left Hand (LH) fan exhaust cowl:
- the PDU is installed on the upper part,
- the ETRAC and TRPU are installed on the middle side,
- the TLS filter box is installed on the lower part.



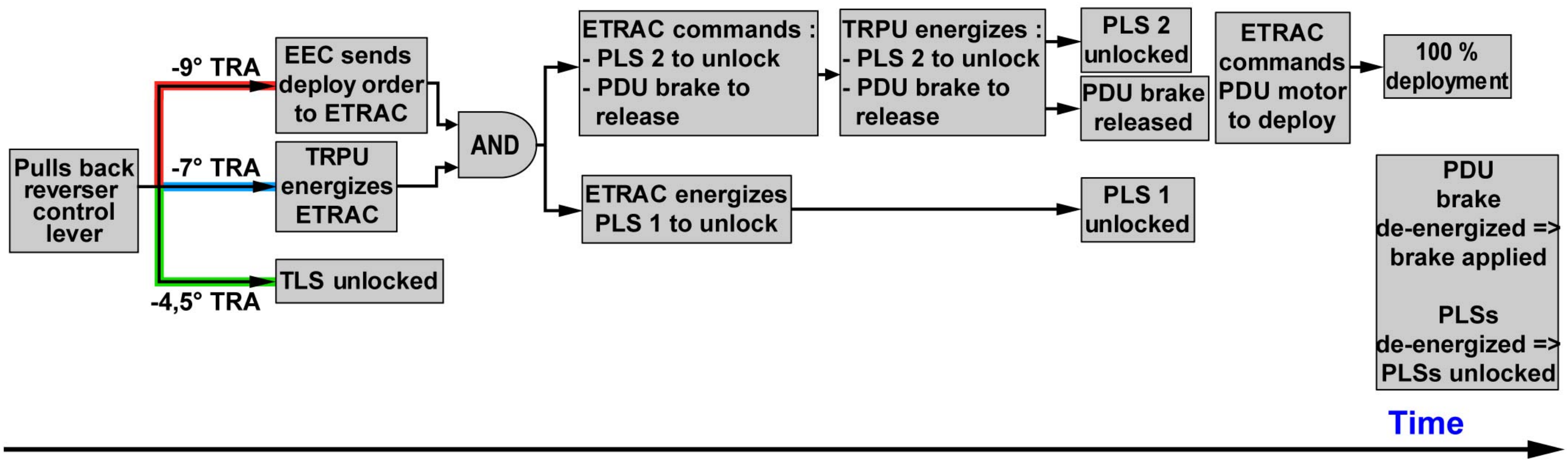
MAJOR COMPONENT IDENTIFICATION

THRUST REVERSER CONTROL DESCRIPTION (3)

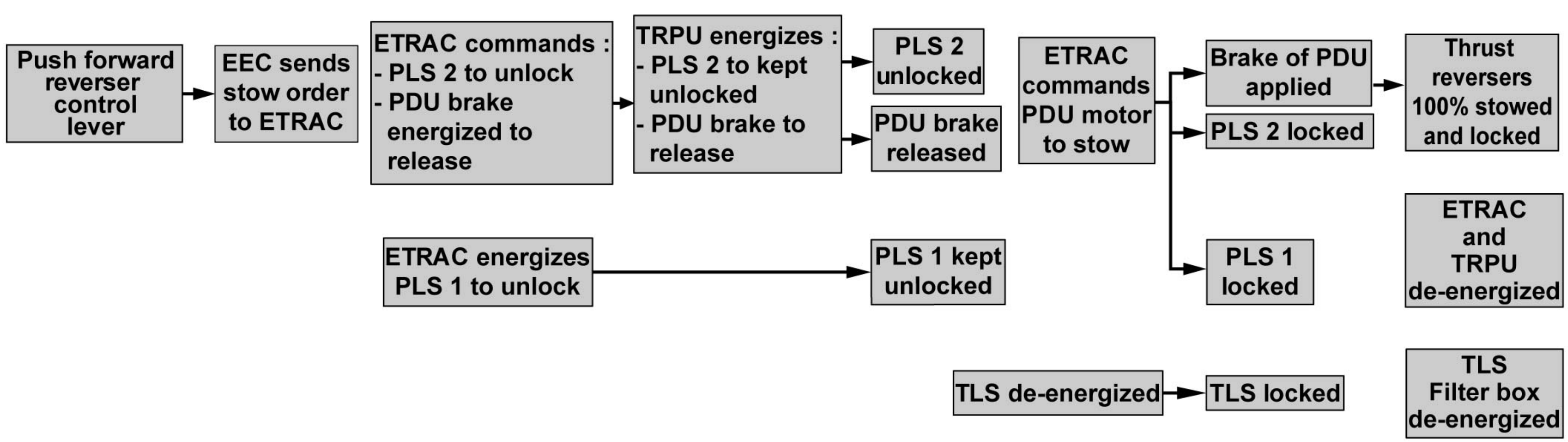
Summary

The following schematic summarizes the deploy and stow sequence.

Deploy Sequence



Stow Sequence



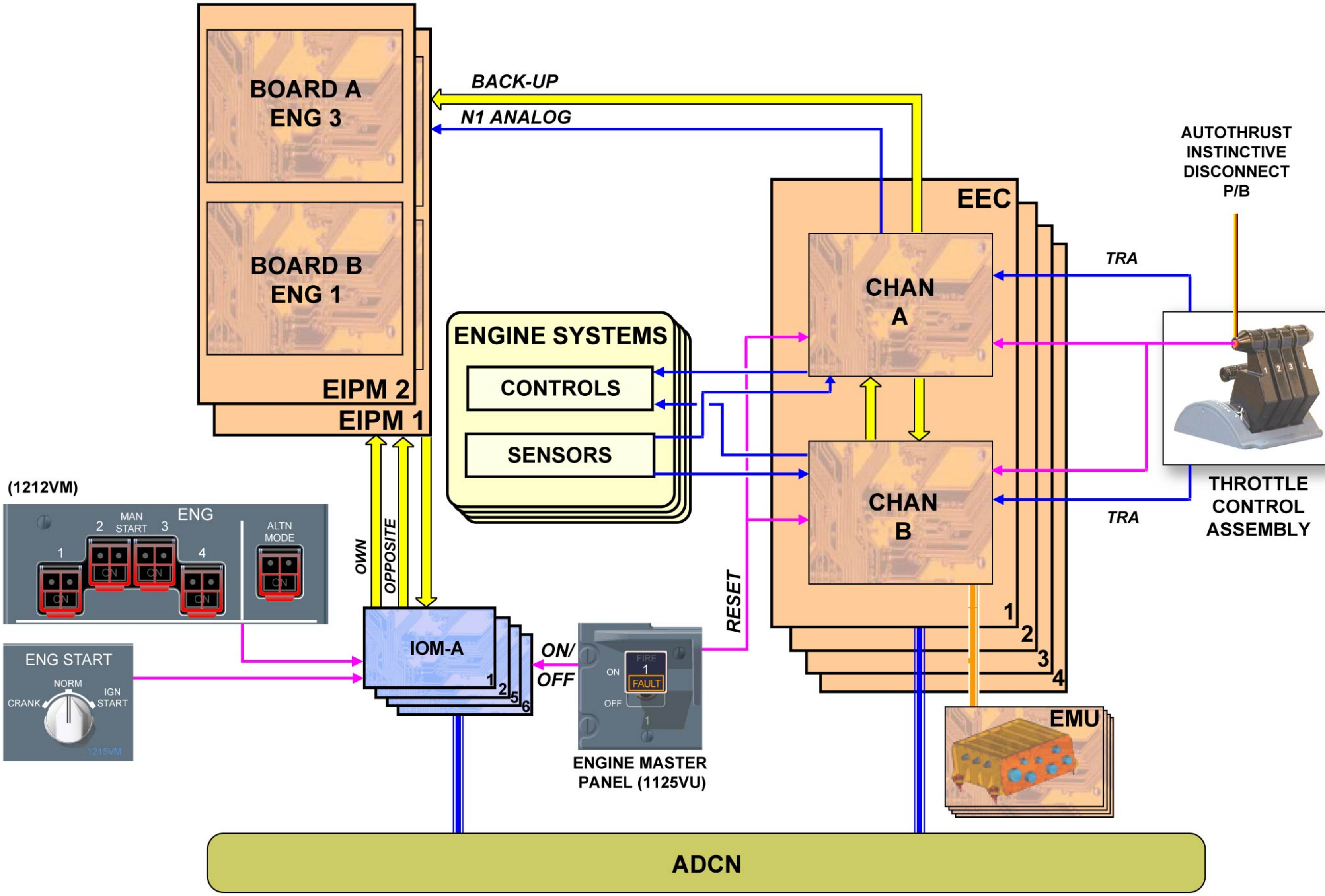
SUMMARY

FADEC ARCHITECTURE & INTERFACE DESCRIPTION (3)

FADEC Overview

The Full Authority Digital Engine Control (FADEC) system, together with aircraft systems, gives the control for engine starting, shut down, power management and engine indicating. The FADEC system is controlled and monitored by an Engine Electronic Controller (EEC). The EEC is a dual channel digital unit. The EEC reads inputs from the aircraft and the engine systems and provides engine control and cockpit indications.
Output data from the channel A of the EEC is sent to the Engine Interface Power Management (EIPM) computer via an ARINC 429 bus, for Back-up purpose. The EEC sends also a N1 ANALOG speed back-up signal directly wired to the EIPM. The N1 speed value is then forwarded to the IOM through ARINC 429 bus.
Each channel of the EEC receives its own Throttle Resolver Angle (TRA) analog signal from the Throttle Control Assembly, independently from the AFDX network through two dedicated resolvers.
The Autothrust (A/THR) instinctive disconnect discrete signal is directly hardwired to each channel of the EEC. Both A/THR instinctive disconnect P/Bs are used by the flight crew to disengage the A/THR mode on all engines.
The EEC exchanges signals and data with the Engine Monitoring Unit (EMU). The EMU analyses data from engine sensors such as pressure sensors, accelerometers, tachometers and electrical magnetic chip detectors. The EMU gives a report on the engine condition and identifies irregular data. Some processed data are sent from the EMU to the EEC for cockpit display.
EEC acquires the following discrete signals from cockpit panels, through 4 IOMS and the Avionics Data Communication Network (ADCN):
- Rotary selector CRANK/NORM/IGN START position
- ENG MAN START p/b switches status
- ENG ALTN MODE p/b switch status (for N1 Back-up mode)
- MASTER lever position ON/OFF (one per engine), to initiate the Engine Starting sequence (in Automatic Start) or to turn the fuel on (in Manual Start or Wet crank).

A discrete signal is directly hardwired from the MASTER lever to each channel of the EEC for EEC reset, and to keep the MASTER Lever position in case of AFDX failure.
The MASTER Lever FAULT light is managed by the EIPM, based on digital data received from the related EECs (own and opposite), via the 4 IOMs.



FADEC OVERVIEW

FADEC ARCHITECTURE & INTERFACE DESCRIPTION (3)

EEC Aircraft Interfaces

EEC has digital interfaces, analog and discrete inputs/outputs.

EEC Digital Interfaces

The four EECs have digital interfaces with the aircraft systems through the ADCN.
The IOMs transmit cockpit commands (Master Lever, Rotary Selector, N1 P/B, Man Start P/B) and the EIPM and the Anti-Ice Control Unit (AICU) data to the EEC.
The EIPMs receive, via the IOM, engine status data (speed, starting, shutdown, reverse inhibition, reverse locked...) from the EEC own and opposite data busses.
The Anti-Icing Control Unit (AICU) receives, via the IOM, data on engine running, maximum take off/go around, flex take off and derated take off limit mode selected. It sends Wing Anti-Ice/Nacelle Anti-Ice (WAI/NAI) status to the EEC for engine thrust modulation.
The Engine Bleed Air System (EBAS), the Pneumatic Air Distribution System (PADS) and the Overheat Detection System (OHDS) are hosted in CPIOM-A. Those systems receive data from the EEC concerning:
- Engine status (engine starting and running, reverse operation) and starting information for Pack closure,
- Engine pressure & temperatures (P0, P30, T30),
- Starter control valve position,
- Burst duct detection (to OHDS).
The EBAS, the PADS and the OHDS send data to the EEC concerning:
- Bleed configuration status,
- HP/IP Command,
- Bleed manifold Pressure,
- Cross-bleed valves position,
- APU isolation valve.

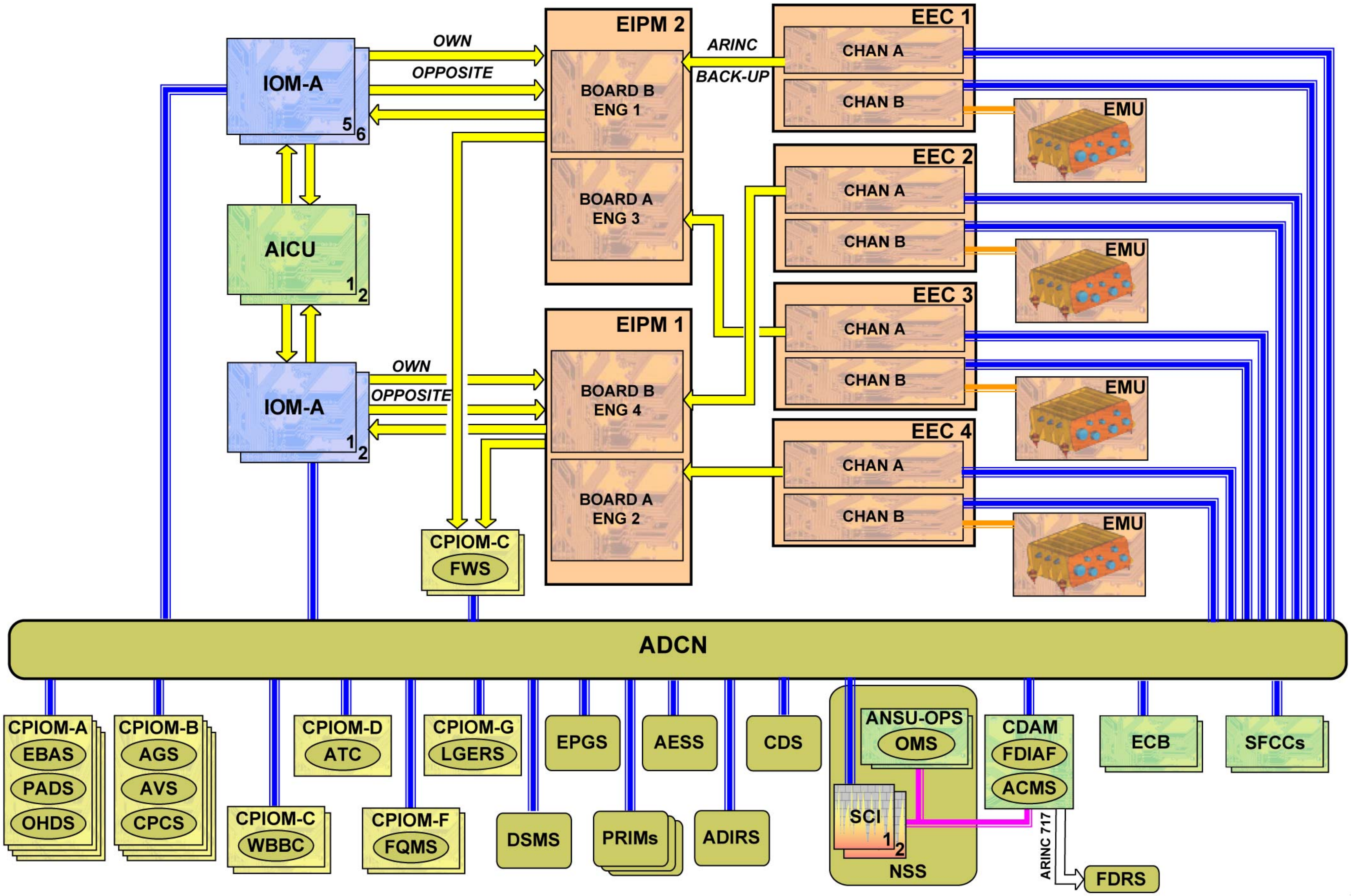
The Avionics Ventilation Control and Monitoring System (AVCMS), the Air Generation System (AGS) and the Cabin Pressure Control System (CPCS) are hosted in CPIOM-B (AVCMS hosted in B3 abd B4). The AVCMS receives data from the EEC concerning the Engine Status (engine running/ not running). The CPCS receives data from the EEC concerning the Engine running, the engine take-off power and the N1 speed. The AGS receives engine starting information for the closure demand of the pack valves from the EEC.
The Flight Warning System (FWS) is hosted in CPIOM-C: It receives engine failures warning annunciation and engine status (speed, starting, shutdown, reverse operation) from the EEC via the ADCN and from EIPM in back up with ARINC 429 bus.
The Weight and Balance Back-up Computer (WBBC), hosted in CPIOM-C, receives data on fuel used from the EEC.
The Air traffic Control (ATC) is hosted in CPIOM-D1 and receives data from the EEC on engine status (engine running, not running...).
The Fuel Quantity Management System (FQMS) is hosted in CPIOM-F: It receives Fuel used data from the EEC and sends fuel temperature data to the EEC.
The Landing Gear Extension Retraction System (LGERS) is hosted in CPIOM-G: It sends wing and body landing gears status (for flight/ground status computation) to the EEC.
The Doors and Slides Management System (DSMS) receives engine running data from the EEC.
The Electrical Power Generating System (EPGS) receives data from the EEC on the engine status (MASTER lever OFF, engine Start/crank sequence active) and on engine speeds N3.
The PRIM (Flight controls and Guidance Computer) receives Engine status (speed, starting, shutdown, reverse operation) and autothrust feedbacks (actual thrust, commanded thrust, thrust limits...) from the EEC. It sends to the EEC:
- Autothrust command,
- Autothrust engaged and active signals,

- Alpha floor protection,
- Throttle position (for consolidation of EEC signals),
- T/O mode selection input (Flex temperature, derated T/O levels, Derated Climb levels),
- Thrust Control Malfunction (TCM) permission discrete command,
- Wheel speed (provision).

The Aircraft Environment Surveillance System (AESS) receives Engine running, selected take off power and thrust data from the EEC.
The Air data and Inertial reference System (ADIRS) receives engine running data and engine Ps, Pt, TAT (for consolidation of ADIRU internal parameters) data from the EEC. The ADIRS sends air data parameters (Ps, Pt, TAT, Mn), probe heat status (pitot, L/H static, TAT, AOA), and calibrated airspeed (CAS) (T900 only) to the EEC.
The ECB (APU controller) receives start sequence signal for the APU boost from the EEC and sends APU availability signal (for bleed configuration determination) to the EEC.
The Slat/Flap Control Computer (SFCC) sends slat/flap configuration (for approach selection) to the EEC.
The Command and Display System (CDS) receives from the EEC:
- Engine Primary parameters (THR, N1, EGT),
- Engine secondary parameters (N2, N3, FF, Fuel used, oil quantity, oil temperature, oil pressure, vibration levels),
- Engine status (speed, starting, shutdown, reverse operation).

The Aircraft Condition Monitoring System (ACMS) and the Flight Data and Interface/Acquisition Function (FDIAF) are hosted in the Centralized Data Acquisition Module (CDAM). Those systems receive engine data for performance and trend monitoring, engine manufacturer's reserved parameters, and EMU advanced Maintenance reports.
The Flight data Recording System (FDRS), linked on the CDAM, receives data from the EEC concerning:
- PS3, Regulated Pressure, Engine bleed demand/K factors,
- N1/TPR limit, N2, N3,
- Each thrust reverser position, and throttle / power lever position,
- EGT, oil quantity, Engine Vibration, oil temperature, and oil pressure,
- HP/LP fuel valve,
- Fuel flow, and derated take-off,
- Position engine relight indication,
- Thrust command,
- Engine warning (each engine vibration),
- Thrust/Power on each engine.

The CDAM transmits its data to the OMS (Onboard Maintenance System).
The OMS application interfaces with ADCN through the Secure Communication Interface (SCI) data.



EEC AIRCRAFT INTERFACES - EEC DIGITAL INTERFACES

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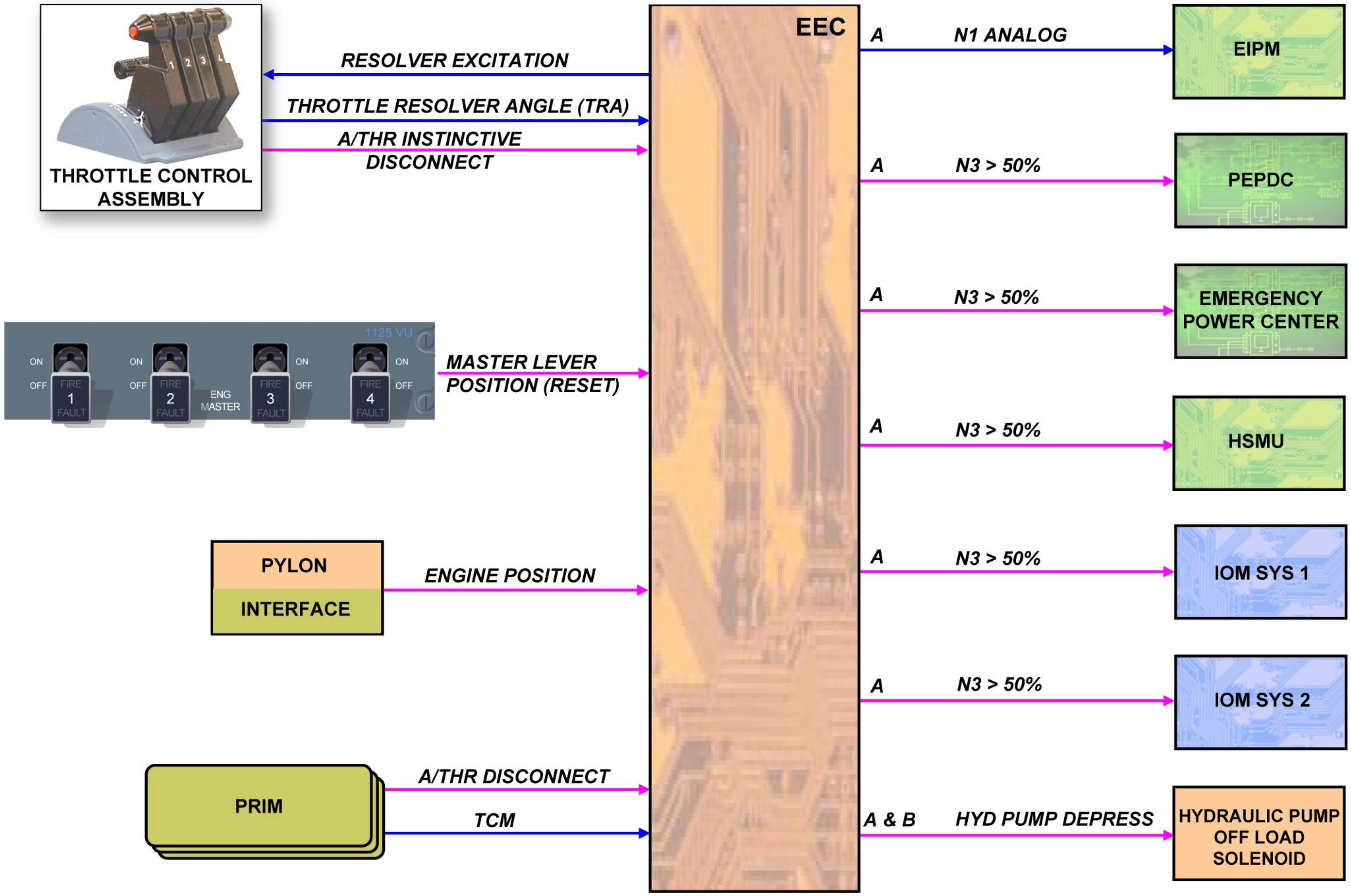
FADEC ARCHITECTURE & INTERFACE DESCRIPTION (3)

EEC Aircraft Interfaces (continued)

EEC Analog and Discrete Inputs/Outputs

The EEC has direct interfaces with aircraft systems and cockpit controls. It receives and sends analog and discrete data.
Control of the engines is achieved by modulation of a throttle lever angle.
The Throttle Control Assembly (TCA) receives the excitation current for the resolvers from each channel of the EEC.
The Throttle Resolver Angle (TRA) of the throttle lever position is transmitted in analog signals to each channel of the EEC.
A discrete signal from the MASTER lever is directly hardwired to each channel of the EEC, for EEC reset function.
The activation of the A/THR instinctive disconnect P/B is used to disengage the A/THR mode on all engines. An A/THR instinctive disconnect discrete signal is directly hardwired to one EEC channel (internally cross-wired) as well as to the Flight Controls Computers (PRIMs) and to the Flight Warning System.
In order for the Engine Control System to protect against Thrust Control Malfunction (TCM), an independant discrete signal from the aircraft is directly hardwired to each EEC. The purpose of this independant input is to authorise the EEC to shut the engine down if it has detected an uncommanded and uncontrollable thrust excursion, which may affect the aircraft controllability. The TCM protection signal is set by the Flight Controls PRIMary Computer (PRIM).
Each EEC receives from the Airframe hardwired discretes indicating position on the aircraft. These discretes are directly hardwired from the Pylon jonction box to the EEC.
A N1 speed back-up signal will be made available at the aircraft level. The analog signal is wired directly from the N1 sensor on the engine to the EIPM computer. The N1 back-up indication is used to keep as a minimum the N1 display available under the following cases:
- AFDX network failure,
- Complete loss of EEC,
- Complete loss of AFDX busses on the engine.

When engine speed is detected to be higher than 50% N3 (for Trent 900 Engine), both EEC channels set the engine running discrete output. However, only the output from the channel A is planned to be acquired on the aircraft side by the IOMs 1 and 2, the Emergency Power Center, the Primary Electrical Power Distribution Center (PEPDC) and the Hydraulic System Monitoring Unit (HSMU).
For engine in-flight wind milling restart purposes, the EEC has the possibility to depressurize both hydraulic pumps on the engine. To achieve this function, both EEC channels are able to switch one output ground/open discrete signal that commands the depressurization of both engine-driven hydraulic pumps.



EEC AIRCRAFT INTERFACES - EEC ANALOG AND DISCRETE INPUTS/OUTPUTS

FADEC ARCHITECTURE & INTERFACE DESCRIPTION (3)

EEC Command and Sensor Interfaces

The FADEC has to perform engine control and monitoring.
The Data Entry Plug (DEP) is a dual channel serial memory device providing storage for engine specific performance and configuration information. The DEP is a plug and housing, which is fastened to the engine by the use of a lanyard. The data entry plug is only programmed with the applicable data for the engine on which it is installed. It cannot be removed and then installed to a different engine unless it is programmed for that engine.
The data entry plug is programmed with the data that follows:
- Turbofan power ratio trim,
- Engine rating selection,
- EGT trim,
- Engine serial number,
- Idle trim.

NOTE: Note: If the DEP and the engine do not have the same data the engine will not operate normally.

The fuel flow XMTR continuously monitors the fuel flow to the combustion system. The XMTR supplies analog signals to the EEC that are in proportion to the mass fuel flow rate. The EEC uses these signals to calculate the flow rate and the quantity of fuel that has been used. The EEC then transmits this data for display in the cockpit.
The Fuel filter differential pressure switch indicates to the EEC if the fuel filter is coming clogged.
The oil quantity XMTR is installed through an opening in the center of the top face of the oil tank. The EEC uses this signal for display in the cockpit.
The oil pressure XMTR senses the difference between supply and scavenge oil pressures. One XMTR per each channel of the EEC supplies an oil pressure indication.
The oil temperature thermocouples are installed at the top of the scavenge oil filter housing. The system uses the thermocouples that are sensitive to temperature changes. An oil temperature signal is sent through the EEC to the aircraft indicating system.
The filters differential pressure switches (supply and scavenge) compare the difference between upstream and downstream pressure for their related filters.
Dual vibration XDCR signal and magnetic chip detector signal are computed by EMU, which monitors engines performance and trend, engines vibration.
Both channels of the EEC have a T20 thermocouple analog input.
The T25 thermocouple sends, to the EEC, the signal of the Total Air Temperature (TAT) at the IP compressor exit. This signal is used for health monitoring purposes. The signal is input to both channels of the EEC.
The T30 signal is obtained by two single element thermocouples mounted at different radial positions around the engine. Each thermocouple sends a signal to the related channel of the EEC. T30 is the TAT at the HP compressor.
The Exhaust Gas Temperature (EGT), or Turbine Gas Temperature (TGT) is derived from 14 double element thermocouples mounted in the nozzle guide vanes. The thermocouples are wired in parallel by two leads, one in alumel and one in chromel. Each pair of leads is connected to each channel of the EEC.
The TCAF (Turbine Cooling Air Front) probe converts the IP turbine disc-cooling air temperature at the front of the disc into an electrical signal.
The TCAR (Turbine Cooling Air Rear) probe converts the IP turbine disc-cooling air temperature at the rear of the disc into an electrical signal.
TCAF and TCAR thermocouples are used to provide IP Turbine disk overheat detection.

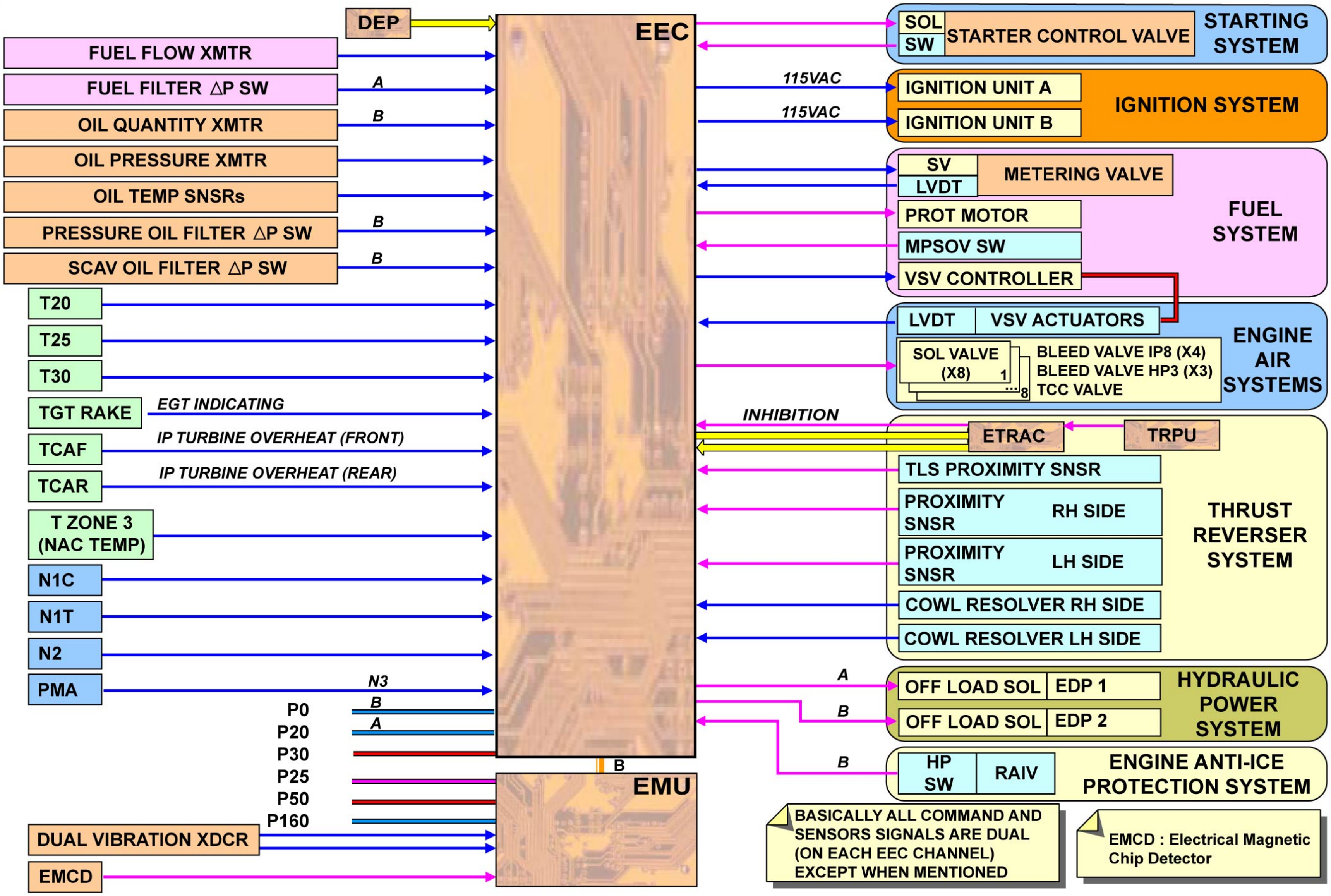
A single thermocouple, mounted on the IP/LP TCC flange, sends to the EEC a temperature signal from Zone 3 nacelle, used for condition monitoring purposes.
The N1C and N1T shaft speeds are derived from engine pulse probes. The probes provide a sinusoidal frequency voltage proportional to the LP compressor and LP turbine shaft speed rotation. The N1 Compressor speed signal is sent to each channel of the EEC, as a main parameter for thrust limitation and N1 mode back-up computation. The comparison between N1C and N1T speeds is used to give a LP Turbine overspeed protection.
The N2 shaft speed signal is derived from engine pulse probes. The probes supply a sinusoidal fraquency voltage proportional to the IP shaft speed rotation. The N2 speed signals are used for engine control functions and are used by the Rotor OverSpeed (ROS) protection. The N2 speed signal is sent to each channel of the EEC.
The N3 shaft speed signal, used within the EEC, is derived from the Permanent Magnetic Alternator (PMA). The outputs from the PMA are at a frequency proportional to the N3 shaft speed and send an N3 speed signal to each channel of the EEC.
The P0 signal is input to channel B.
The P20 probe sends to the EEC, the signal of the Total Air Temperature (TAT) at the engine air intake. The EEC automatically selects the P20 probe heater to prevent ice on the probe air inlets. The P20 signal is input to channel B.
The HP compressor pressure signal called P30 is split inside the EEC to give a pressure tapping to a transducer in each channel. The ratio P30/P20 is used for the TPR thrust computation.
The IP Compressor pressure signal called P25 is input to the EMU for condition monitoring purposes.
The P50 signal is an exhaust gas pressure signal, which is split into the EMU to give a pressure tapping to a transducer in each channel of the EEC.
A fan exit signal called P160 is used for condition monitoring purposes and is input to the EMU.

The EEC controls the starting system during the engine start sequence, the EEC opens the starter control valve to operate pneumatic starter from either APU air, cross-bleed air or an external air source. The EEC receives feedback from the starter control valve position switch.
The EEC supplies the two ignition units (A and B) of the Ignition system with 115 VAC aircraft power.
The EEC controls the fuel flow to the combustion system. The control elements are:
- The Metering valve, which controls the rate of fuel flow (the EEC receives feedback from an LVDT),
- The PROT MOTOR, which has three positions (STBY, TCM, OVSP),
- The MPSOV, which can stop the flow and cause an engine shutdown in case of an overspeed (the feedback is given by the MPSOV switch)
- The VSV controller, which supplies fuel to the VSV actuators (the EEC receives feedback from a LVDT located on the VSV actuators).

In the engine air system, the EEC controls the operation of eight valves:
- Four IP 8 bleed valves,
- Three HP 3 bleed valves,
- The Turbine Case Cooling (TCC) valve.

To prevent an engine surge condition, bleed valves controlled by solenoids are independently supplied with electrical power from the EEC. During cruise condition, the EEC fully opens the TCC valve to supply LP compressor air to the external surface of the turbine cases. This causes a smaller clearance between the cases and the tips of the HP and IP/LP turbine blades to increase turbine performance. There is no feedback of the bleed and the TCC valves.
The EEC controls the Electronic Thrust Reverser Actuation Controller (ETRAC) through an ARINC 429 BUS. The Thrust Reverser Power Unit sends an inhibition signal to the EEC through the ETRAC. The EEC receives feedback from the Tertiary Locking System (TLS) proximity SNSRs, from the RH and LH side proximity SNSRs and from the RH and LH side cowl resolvers.
The EEC controls the hydraulic pump off-load solenoids (channel A for EDP1 and channel B for EDP2) to depressurize the hydraulic system during an in-flight start.

The EEC receives feedback from the engine anti-ice protection system for bleed status demand.
The EEC channel B only monitors the Regulated Anti Ice Valve (RAIV) position by means of a High Pressure Switch.

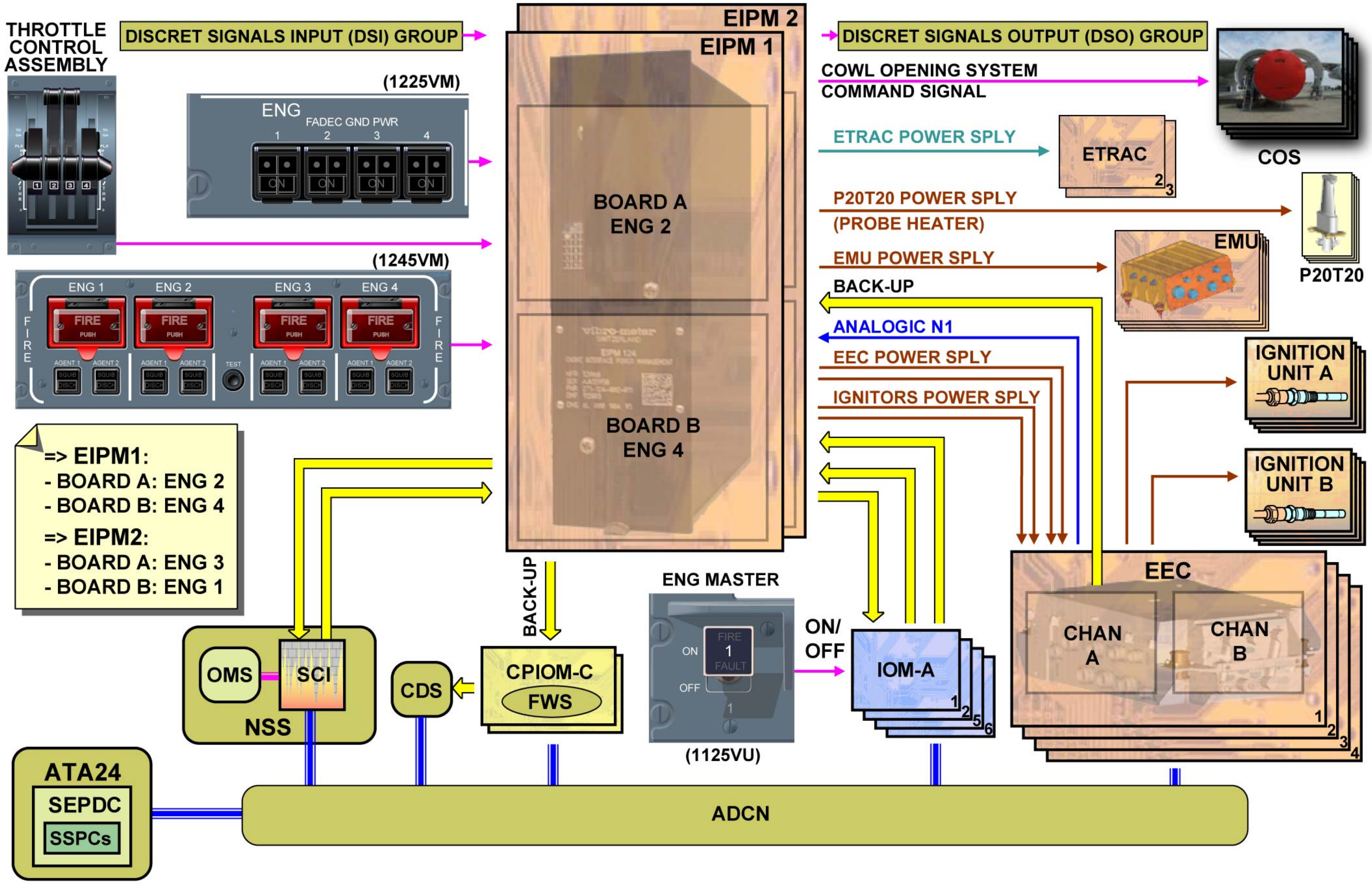


EEC COMMAND AND SENSOR INTERFACES

EIPM ARCHITECTURE & INTERFACE DESCRIPTION (3)

Architecture

There are two Engine Interface Power Management Units (EIPMs) per aircraft, one unit per two engines with dedicated and separated boards and processor per engine.
EIPM1:
-Board A: ENG 2
-Board B: ENG 4
EIPM2:
-Board A: ENG 3
-Board B: ENG 1
The EIPM, installed in the avionics bay, controls and delivers electrical power supply from aircraft towards engine systems.
The basic function of the EIPM is to control and monitor the electrical power supply to:
-Engine Electronic Controller (EEC),
-Cowl Opening System (COS),
-P20T20,
-Electronic Thrust Reverser Actuation Controller (ETRAC),
-Engine Monitoring Unit (EMU),
-Ignitors.
The EIPM converts N1 analog signal in ARINC 429 bus, for back-up.
From a Discrete Signals Input (DSI) group the EIPM generates, for aircraft interface purpose, Discrete Signals Output (DSO) group.
The EIPM exchanges also data via ARINC 429 with:
-The Onboard Maintenance System (OMS) through the Secure Communication Interface (SCI). The OMS and the SCI are in the Network Server System (NSS),
-The Control and Display System (CDS) via the Core Processing Input Output Module (CPIOM) of the Flight Warning System (FWS) as a back-up output,
-The Input Output Module (IOM),
-The EEC Channel A (back-up),
-The Solid State Power Controllers (SSPCs) in the Secondary Electrical Power Distribution Center (SEPDC) via the IOM and the Aircraft Data Communication Network (ADCN).



ARCHITECTURE

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EIPM ARCHITECTURE & INTERFACE DESCRIPTION (3)

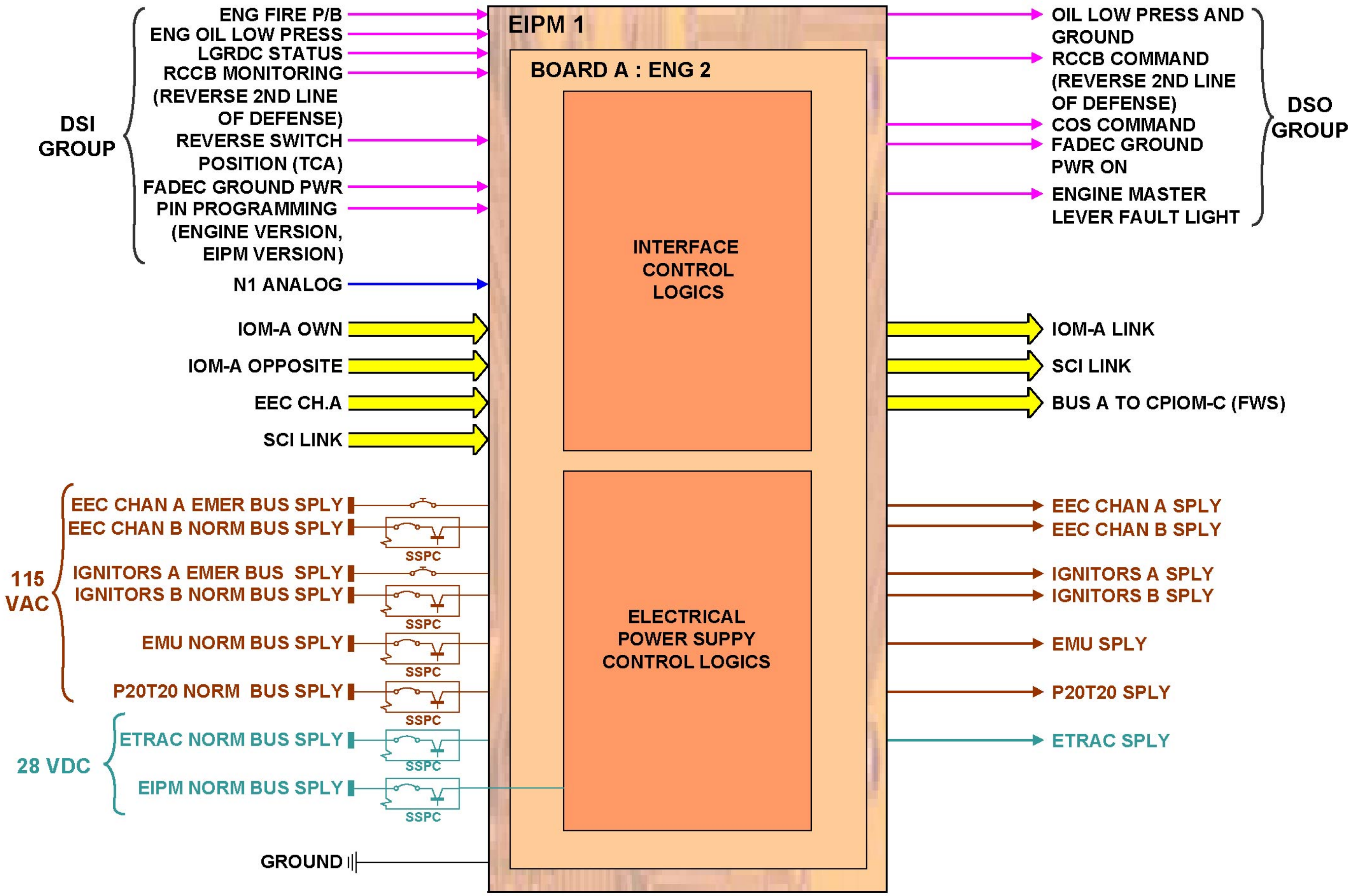
Interfaces

Electrical Power Supply Control Logics

Each electrical power supply normal bus (EEC, Igniters, ETRAC, P20T20, ETRAC, EIPM) is controlled by SSPCs.
In case of EIPM failure or loss, the EEC channels are fail-safe power supplied.
In the EIPM each power supply is controlled by relays, which are controlled by the electrical power supply control logics.

Interface Control Logics

The EIPM proceeds to the control and monitoring of the DSI and DSO groups.
The EIPM computes the "oil low press and ground" signal based on the acquisition and combination of discrete signals from the Landing Gear Remote Data Concentrator (LGRDCs) and Oil Low Press switch, and ARINC signal from IOM (SCI, EEC).
The EIPMU sends (via discrete signal) the "oil low press and ground" signal to other users (IOM, Cabin Intercommunication Data System (CIDS), Flight Control Data Concentrator (FCDC)).
The EIPM controls the second line of defense of the Thrust Reverser system, only according to states of inputs of the LGRDC status, reverse switch position, and ARINC bus. This second line of defense is authorized via discrete output Remote Control Circuit Breaker (RCCB) command.
The EIPM monitors the TR second defense line authorization via the RCCB monitoring input.
The RCCB Command function is only available for engine 2 and engine 3 (inboard engine).
The EIPM controls the opening and closing of the fan Cowl Opening System.
The fan and fan exhaust cowl opening can be done through electrical actuators.
The power supply of Cowls Opening System (COS) is only available when the aircraft is on ground and engine on "oil low press". EIPM also uses ARINC data to manage COS application.
By default, manual cowls opening is inhibited and carried out by the function of COS.
The power supply to the COS is cut in case of action on the "handful fire-break" of the associated engine.
When the Full Authority Digital Engine Control (FADEC) ground power P/B is activated, the EIPMU electrically powers the EEC channels for five minutes (maintenance only) if no OMS interactive mode.
If the ENG FIRE P/B SW is activated, the EIPM cuts-off the electrical power supply to EEC channels for isolation purpose,
The EEC sends the MASTER lever FAULT light (Boolean information) to the EIPM. The EIPM generates a power supply discrete signals to turn the Engine FAULT light on, on the Master Lever.
The EIPM acquires N1 speed in an analog form and transmits it via ARINC 429 to the IOM and the FWC. This information is used as a back up information of the N1 speed from the EEC via the ADCN.



INTERFACES - ELECTRICAL POWER SUPPLY CONTROL LOGICS & INTERFACE CONTROL LOGICS

L1W06161 - L0KT0T0 - LM7RD7000000001

EIPM & FADEC POWER SUPPLY DESCRIPTION (3)

General

The Full Authority Digital Engine Control (FADEC) has two computers:
- Engine Electronic Controller (EEC),
- Engine Monitoring Unit (EMU).

The power supply of the EEC can be processed into two different manners:
- By the airframe power supply (115 VAC) that comes from the Engine Interface Power Management (EIPM),
- By the EEC dedicated alternator, also called Permanent Magnet Alternator (PMA).

EEC is normally powered by its own power supply (PMA), when engine is running.
EMU is supplied by airframe power supply (115 VAC)

WARNING: DO NOT SET THE MASTER LEVER TO THE "ON" POSITION WITH THE ENGINE ROTARY SELECTOR ALREADY IN THE "IGN/START" OR "CRANK" POSITION. ENGINE RISKS TO BE STARTED OR CRANKED

Airframe Power Supply

EIPM is powered in 28 VDC NORMal bus.
The EEC receives power from two airframe 115VAC buses through the EIPM control logic function.
The supply line from the emergency bus is connected into channel A of the EEC and the line from the Airframe Normal bus is connected with channel B of the EEC. In an emergency situation (following loss of all variable frequency generators), only the emergency bus from airframe will operate.
The airframe power supply is available on ground and in flight and shall be used by the EEC for its ground tests, ground engine starting, and in flight starting when engine speed is below 8% N3, or in case of PMA failure.

EEC Dedicated Alternator Power Supply (PMA)

The PMA has a Stator and Rotor that supply two independent three-phase power windings to the EEC (1 per channel). A mechanical drive from the Engine gearbox is used to rotate the PMA Rotor. The interface is required to power the EEC in all Engine running conditions.
When the engine speed is above 8% N3, the PMA will deliver the electrical power necessary for the EEC to achieve its functions including in-flight starter assist or wind-milling engine starting.
Note: Between 5% and 8% of N3 the power supply to the EEC is shared between airframe power and PMA power.
Note: one single phase is also dedicated to N3 sensing.

FADEC Power Supply

Aircraft Power-Up

At aircraft Power-up or EIPM initialization, the EEC and the EMU will be powered as detailed below:
Channel A will be powered if with the airframe 115 VAC Emergency bus is available,
Channel A & B and the EMU will be powered for 5 minutes if the full airframe electrical network is available.

Engine Mode Selector

With engine not running:
-When you set the ENG START rotary selector to "CRANK" or "STAR/IGN" position, the EEC and the EMU are permanently supplied,
-When you set the ENG START rotary selector to the "NORM" position the power supply of the EECs and the EMU is cut off

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Engine Master Lever

With engine not running:
-Each ENG MASTER lever in the "ON" position supplies permanently the related EEC and EMU.
On the ground, airframe 115 VAC will be removed from the EEC and EMU 15 minutes after selection of the ENG MASTER lever from the "ON" to "OFF" position. This will not occur in flight.

Engine FADEC Ground Power

For maintenance operation, with the ENG FADEC GrouND PoWeR P/B selected to the "ON" position and the EEC interactive mode not instigated, airframe 115 VAC will be cut off for 5 minutes.
The airframe 115 VAC power will be cut off immediately by selecting the ENG FADEC GrouND PoWeR P/B to the "OFF" position or by returning the ENG rotary selector to the "NORM" position (with the ENG MASTER lever to the "OFF" position).

Engine Fire Push-Button

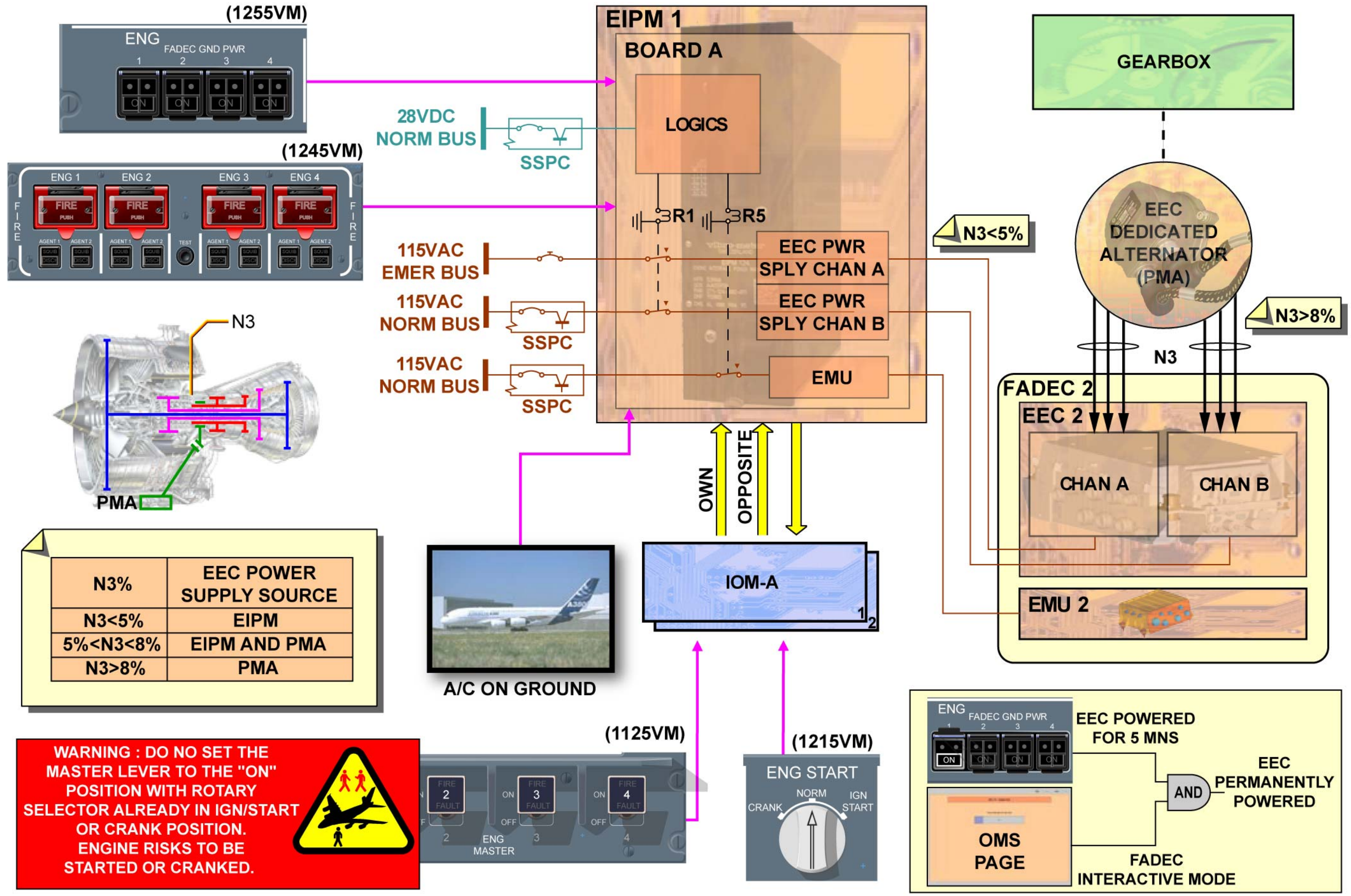
In the case of fire, in flight or on ground, airframe 115 VAC power will be cut off immediately following operation of the ENGine FIRE P/B SW.

EIPM-Failure

In the event of EIPM failure, airframe 115 VAC power will be permanently available to the EEC whenever the airframe electrical network is powered.

EEC Dedicated Alternator Failure

If the EEC dedicated alternator winding for the EEC channel in control becomes defective, there will be an EEC channel change over if the second winding is healthy.
If both alternators power supply is lost, the EEC will be supplied by the airframe 115 VAC through the EIPM.



N3%	EEC POWER SUPPLY SOURCE
N3<5%	EIPM
5%<N3<8%	EIPM AND PMA
N3>8%	PMA

GENERAL & FADEC POWER SUPPLY

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FADEC MAINTENANCE (3)

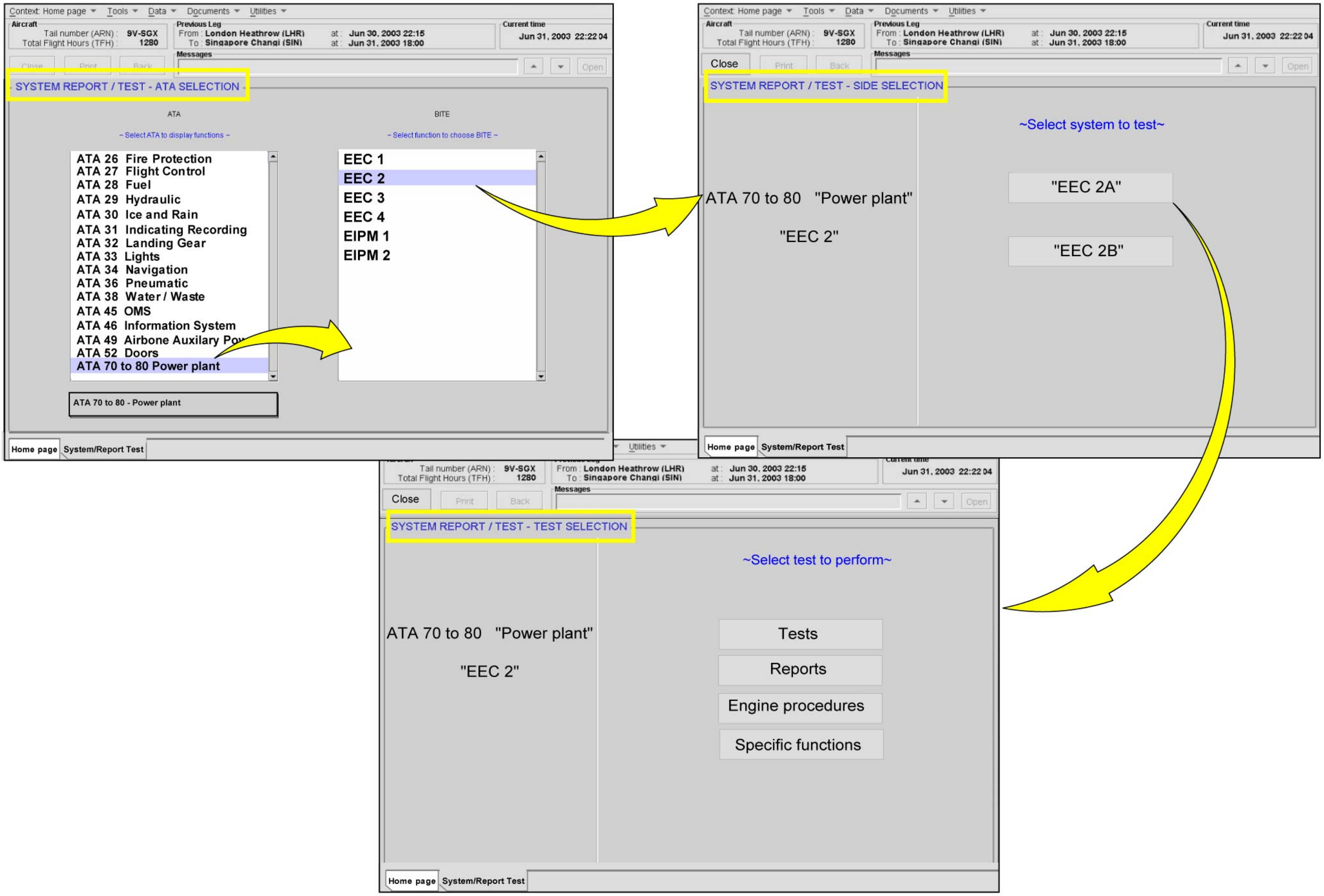
Tests

The Onboard Maintenance System (OMS) is used for the test of two main computers of the power plant system:
- EEC (Engine Electronic Controller)
- EIPM (Engine Interface Power Management)

These tests are launched from the OMS Human-Machine Interface (HMI) using the Onboard Maintenance Terminal (OMT), Onboard Information Terminal (OIT) or Portable Multipurpose Access Terminal (PMAT).

EEC

To reach the "TEST SELECTION" page, you must select the ATA and the system to test in the "ATA SELECTION" page. Then you select the channel in the "SIDE SELECTION".
The EEC gives the following interactive tests, reports, engine procedures, specific functions:



TESTS - EEC

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FADEC MAINTENANCE (3)

Tests (continued)

Tests

AUDIBLE TEST OF THE IGNITERS

The EEC cannot detect the operation of the igniter during the test. Even if the test is OK, the result is indicated; you have to make sure that you hear sparks from the ignition system on the engine.

VARIABLE-STATOR-VANES SYSTEM TEST

The engine will be dry cranked during the test.

CAUTION: YOU SET THE CONTROLS AS SPECIFIED IN THE PROCEDURE DISPLAYED ON THE OMS, THE DRY CRANK WILL START IMMEDIATELY.

TEST OF THE P20T20 PROBE HEATER

CAUTION: THE P20T20 PROBE WILL BE ENERGIZED FOR 5 SECONDS AND BECOMES HOT DURING THIS TEST.

Make sure that not cover, cap or plug is installed on the P20T20 probe.

HYDRAULIC PUMP OFFLOAD TEST

The engine will be dry cranked during the test.

CAUTION: YOU SET THE CONTROLS AS SPECIFIED IN THE PROCEDURE DISPLAYED ON THE OMS, THE DRY CRANK WILL START IMMEDIATELY. IN THIS TEST YOU MUST LOOK TO SEE IF THE HYDRAULIC PRESSURE INCREASES AND DECREASES AT THE APPLICABLE TIMES.

HARNESS TEST

This test monitors the Full Authority Digital Engine Control (FADEC) system for 15 minutes and looks for faults while you shake the harness.

THRUST REVERSER CYCLING TEST

Note: This test is only done onto the EEC of the inboard engines.

WARNING: THRUST REVERSER WILL BE ENERGIZED AND MOVED DURING TEST. MAKE SURE THAT THE THRUST REVERSER AREA IS CLEAR AND CLEAN OF PERSONS AND TOOLS OR OTHER ITEMS.

Make sure that the thrust reverser is not in the inhibited position. Move the throttle lever to reverse idle within 50 seconds, then move the throttle lever to forward idle within 50 seconds.

Reports

The reports are the same for the two channels of the four EEC.

EGT EXCEEDANCE REPORT
SHAFT-SPEED
THE STATUS OF AIRCRAFT HARDWIRED INPUTS

Engine Procedures

The engine procedures are the same for the two channels of the four EEC.

FAN TRIM BALANCE
ENGINE CORE WASHING
BLEED-VALVE TEST SCHEDULING

CAUTION: THE ENGINE IS STARTED TO PROVIDE THE AIR PRESSURE TO OPERATE THE BLEED VALVES WHEN COMMANDED BY EEC

Specific Functions

The specific functions are the same for the two channels of the four EEC.

ENGINE RUNNING SIMULATION

Engine run discrete signal simulation. The engine is not started for this test

RESET FUEL USED

EEC 2 CHAN B AND EEC 3 CHAN A & B ARE SIMILAR TO EEC 2 CHAN A.
EEC 1 CHAN A & B AND EEC 4 CHAN A & B ARE SIMILAR TO EEC 2 CHAN A, MINUS THRUST REVERSER CYCLING TEST.

EEC 2 CHAN A	TESTS	AUDIBLE TEST OF THE IGNITERS	THE EEC CANNOT DETECT THE OPERATION OF THE IGNITER DURING THE TEST. EVEN TEST OK RESULT IS INDICATED, YOU HAVE TO MAKE SURE THAT YOU HEAR SPARKS FROM THE IGNITION SYSTEM ON THE ENGINE.
		VARIABLE-STATOR-VANES SYSTEM TEST	THE ENGINE WILL BE DRY CRANKED DURING THE TEST CAUTION : YOU SET THE CONTROLS AS SPECIFIED, THE DRY CRANK WILL START IMMEDIATELY.
		TEST OF THE P20T20 PROBE HEATER	CAUTION : THE P20T20PROBE WILL BE ENERGIZED FOR 5 SECONDS AND GETS HOT DURING THIS TEST. MAKE SURE THAT NOT COVER, CAP OR PLUG IS INSTALLED ON THE P20T20 PROBE.
		HYDRAULIC PUMP OFFLOAD TEST	THE ENGINE WILL BE DRY CRANKED DURING THE TEST. CAUTION : YOU SET THE CONTROLS AS SPECIFIED, THE DRY CRANK WILL START IMMEDIATELY. IN THIS TEST YOU MUST LOOK TO SEE IF THE HYDRAULIC PRESSURE INCREASES AND DECREASES AT THE APPLICABLE TIMES.
		HARNESS TEST	THIS TEST MONITORS THE FADEC SYSTEM FOR 15 MINUTES AND LOOKS FOR FAULTS WHILE YOU SHAKE THE HARNESS.
		THRUST REVERSER CYCLING TEST	WARNING : THRUST REVERSER WILL BE ENERGIZED AND MOVE DURING TEST. MAKE SURE THAT THE THRUST REVERSER AREA IS CLEAR AND CLEAN OF PERSONS AND TOOLS OR OTHER ITEMS. MAKE SURE THAT THE THRUST REVERSER IS NOT IN INHIBITED POSITION. MOVE THROTTLE LEVER TO REVERSE IDLE WITHIN 50 SECONDS. MOVE THROTTLE LEVER TO FORWARD IDLE WITHIN 50 SECONDS.
	REPORTS	EEC CONFIGURATION	
		EGT EXCEEDANCE REPORT	
		SHAFT-SPEED EXCEEDANCE REOPRT	
	ENGINE PROCEDURES	FAN TRIM BALANCE	
		ENGINE CORE WASHING	
		BLEED-VALVE TEST SCHEDULING	CAUTION : THE ENGINE IS STARTED TO PROVIDE THE AIR PRESSURE TO OPERATE THE BLEED VALVES WHEN COMMANDED BY EEC.
	SPECIFIC FUNCTIONS	ENGINE RUNNING SIMULATION	ENGINE RUNNING DISCRETE SIGNAL SIMULATION. THE ENGINE IS NOT STARTED FOR THIS TEST.
		RESET FUEL USED	

TESTS - TESTS ... SPECIFIC FUNCTIONS

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FADEC MAINTENANCE (3)

Tests (continued)

EIPM

To reach the "TEST SELECTION" page, you must select the ATA and the system to test in the "ATA SELECTION" page. Then you select the channel dedicated to an engine in the "SIDE SELECTION" page.
The EIPM gives the following interactive tests, reports and Specific function:

Tests

The tests are the same for each EIPM

GROUND POWER LIGHT
ENGINE LIGHT FAULT

Reports

The reports are the same for each EIPM

DISCRETE INPUTS REPORTS
DISCRETE OUTPUTS REPORTS
PIN PROGRAMMING REPORTS

Specific Function

OIL LOW PRESS AND GROUND

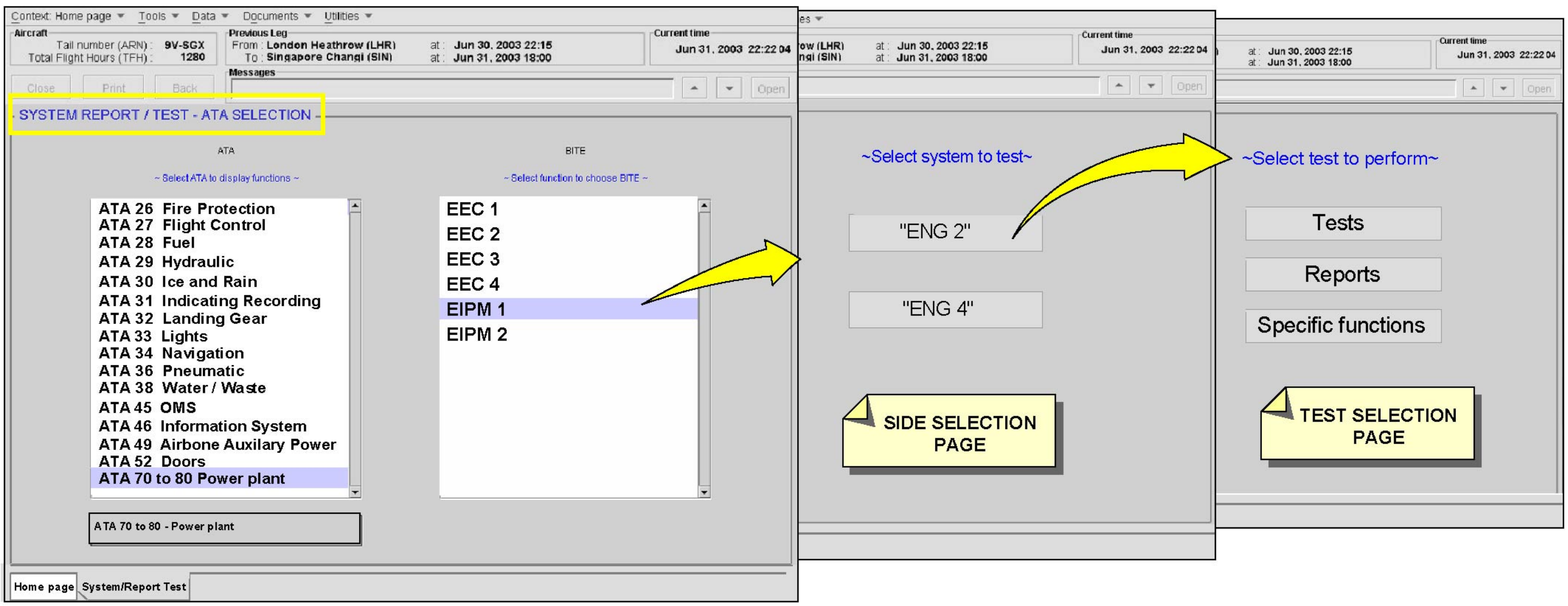
On the EIPM 1 ENG 2 and the EIPM 2 ENG 3 there are two other specific functions:

THRUST REVERSER 3*115 V / 25 KW POWER SUPPLY

WARNING: REVERSE SECOND LINE OF DEFENSE WILL BE DEACTIVATED; POSSIBLE REVERSE DOORS ACTIVATION CAN OCCUR.

ETRAC MANUAL POWER SUPPLY

WARNING: ELECTRONIC THRUST REVERSER ACTUATION CONTROLLER (ETRAC) WILL BE POWER SUPPLIED; POSSIBLE REVERSE DOORS ACTIVATION CAN OCCUR.



EIPM 2 ENG 3 IS SIMILAR TO EIPM 1 ENG 2. EIPM 1 ENG 4 AND EIPM 2 ENG 1 ARE SIMILAR TO EIPM 1 ENG 2, MINUS THRUST REVERSER 3*115 / 25 KW POWER SUPLLY AND ETRAC MANUAL POWER SUPPLY.

EIPM 1 ENG 2	TESTS	FADEC GROUND POWER LIGHT	
		ENGINE LIGHT FAULT	
	REPORTS	DISCRETE INPUTS REPORTS	
		DISCRETE OUPUTS REPORTS	
		PIN PROGRAMMING REPRTS	
	SPECIFIC FUNCTIONS	OIL LOW PRESS AND GROUND	
		THRUST REVERSER 3*115 V / 25 KW POWER SUPLLY	WARNING : REVERSE SECOND LINE OF DEFENSE WILL BE DEACTIVATED => POSSIBLE REVERSE DOORS ACTIVATION
		ETRAC MANUAL POWER SUPPLY	WARNING : ETRAC WILL BE POWER SUPPLIED => POSSIBLE REVERSE DOORS ACTIVATION

TESTS - EIPM ... SPECIFIC FUNCTION

L1W06161 - L0KT0T0 - LM7RY2000000001

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

General

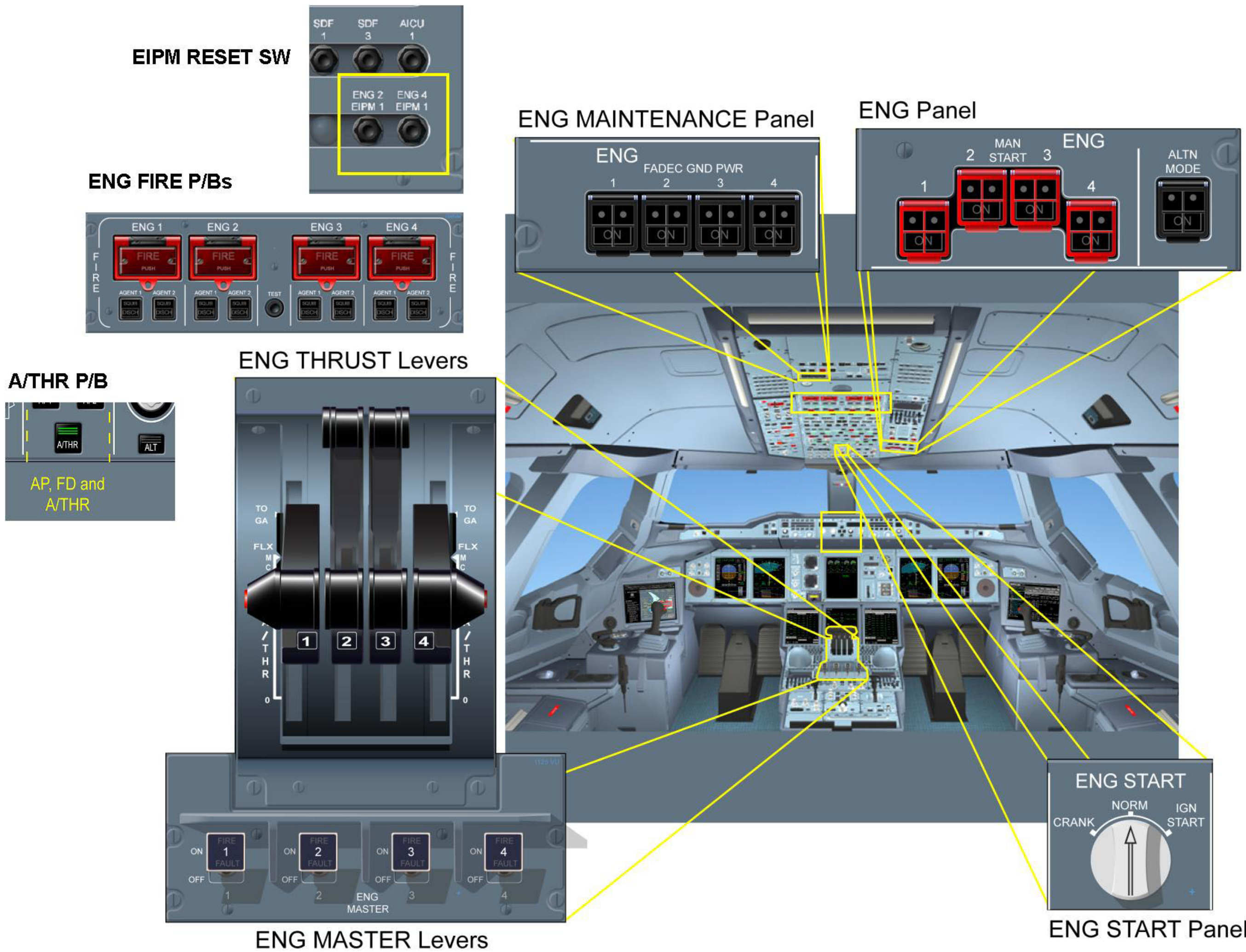
GENERAL

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

General (continued)

Preliminary Cockpit Preparation

Engine Control Panels Location



GENERAL - PRELIMINARY COCKPIT PREPARATION & ENGINE CONTROL PANELS LOCATION

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Controls and Indication Presentation

EEC Powering / Depowering

NOTE: The MASTER LEVER could be used for powering the FADEC.
In this case, the dedicated FADEC will be powered for 15 minutes, but it is not recommended on A/C, because there is a risk of the engine to be started if the rotary selector has been forgotten in IGN START position.
If you do, observe quick ON and OFF action, because you do not have to forget that when the MASTER LEVER is set to ON the LP fuel SOV is controlled to open.

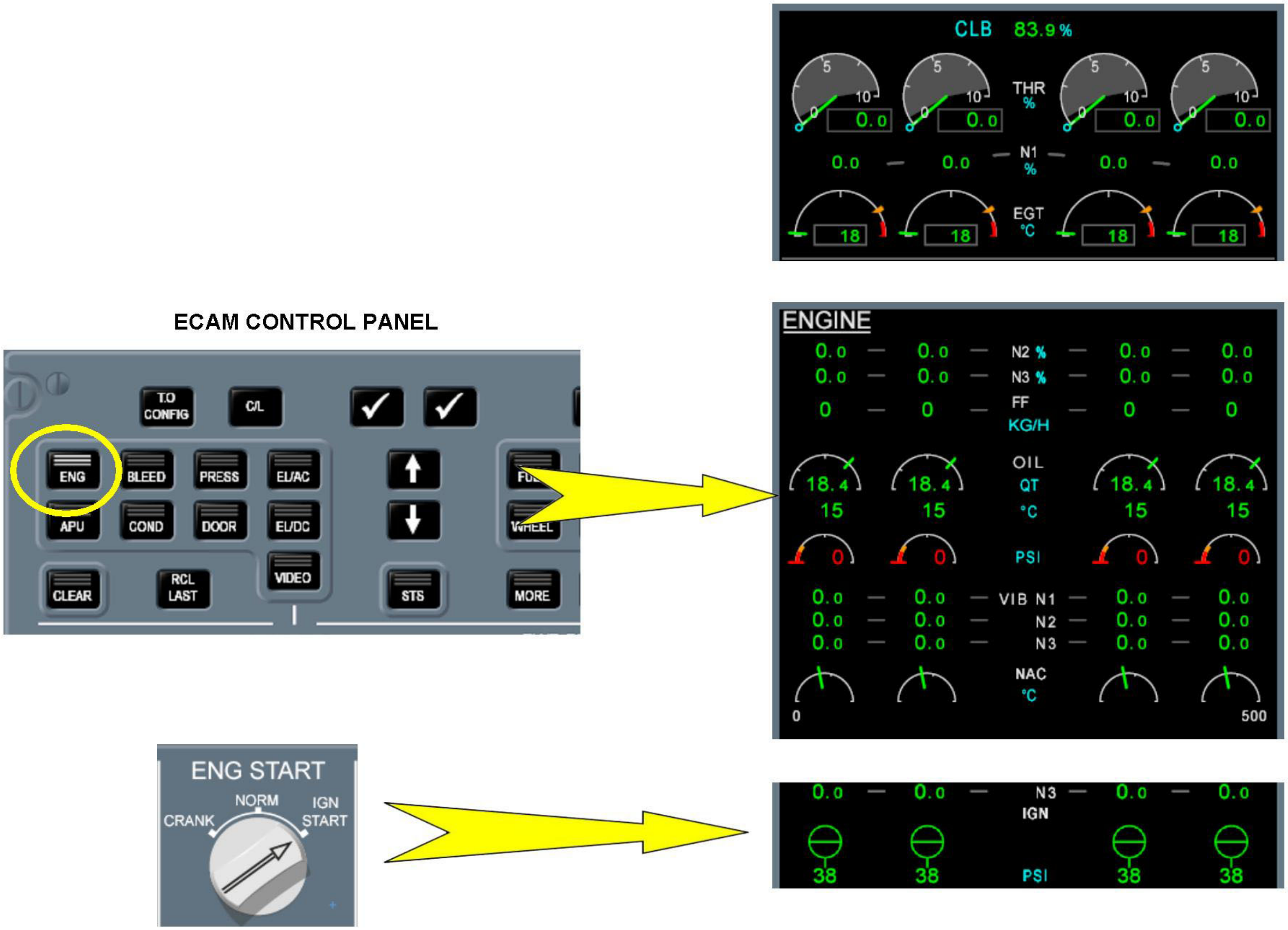
CAUTION: WITH ENG FIRE PUSH BUTTON RELEASED OUT, THE FIRE EXTINGUISHERS ARE ARMED. DO NOT PRESS ON THE AGENT P/BSWs.

ENGINE CONTROLS AND INDICATION PRESENTATION - EEC POWERING / DEPOWERING

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Controls and Indication Presentation (continued)

Engine Parameters Display



ENGINE CONTROLS AND INDICATION PRESENTATION - ENGINE PARAMETERS DISPLAY

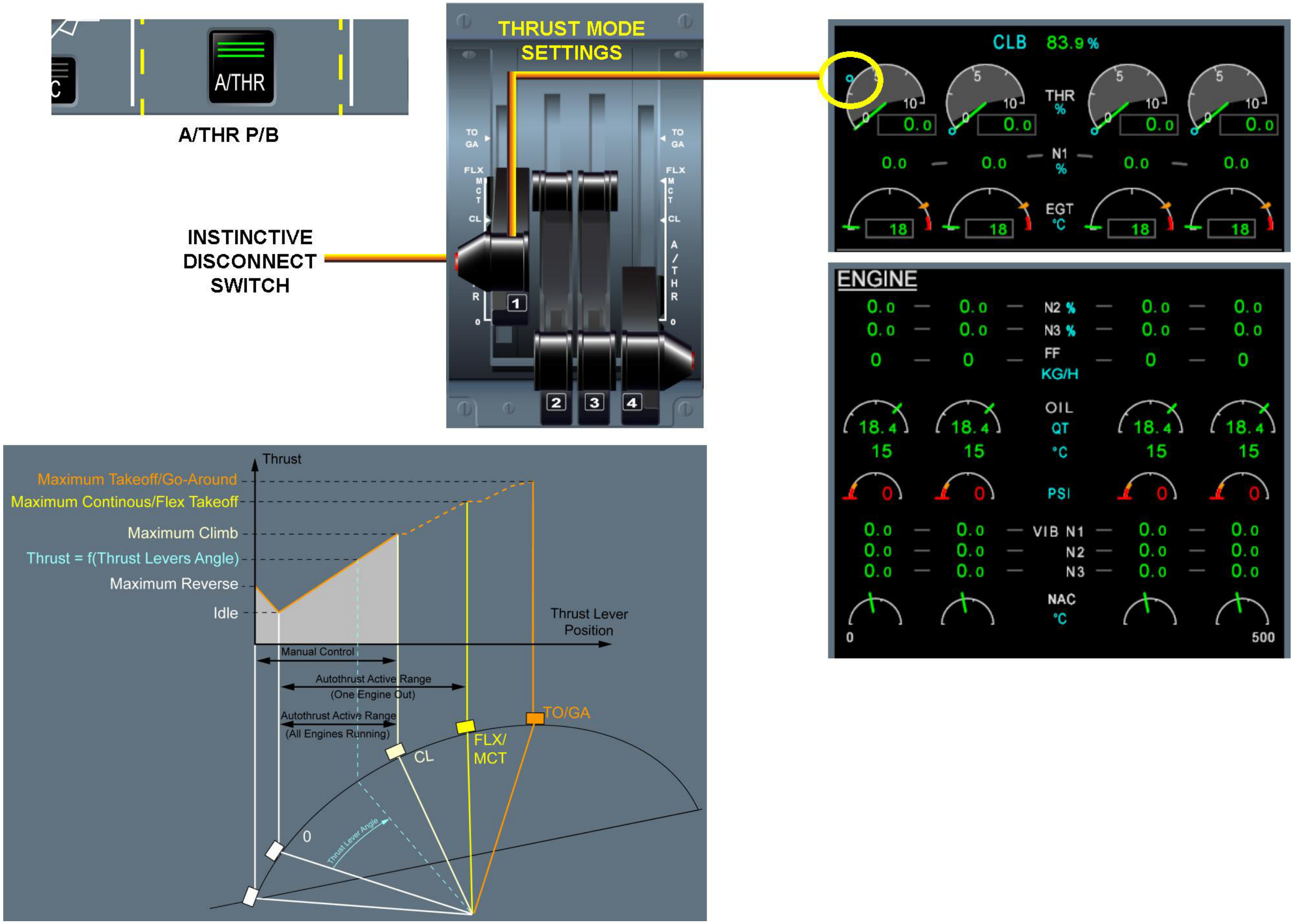
L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Controls and Indication Presentation (continued)

Thrust Levers

A/THR P/B



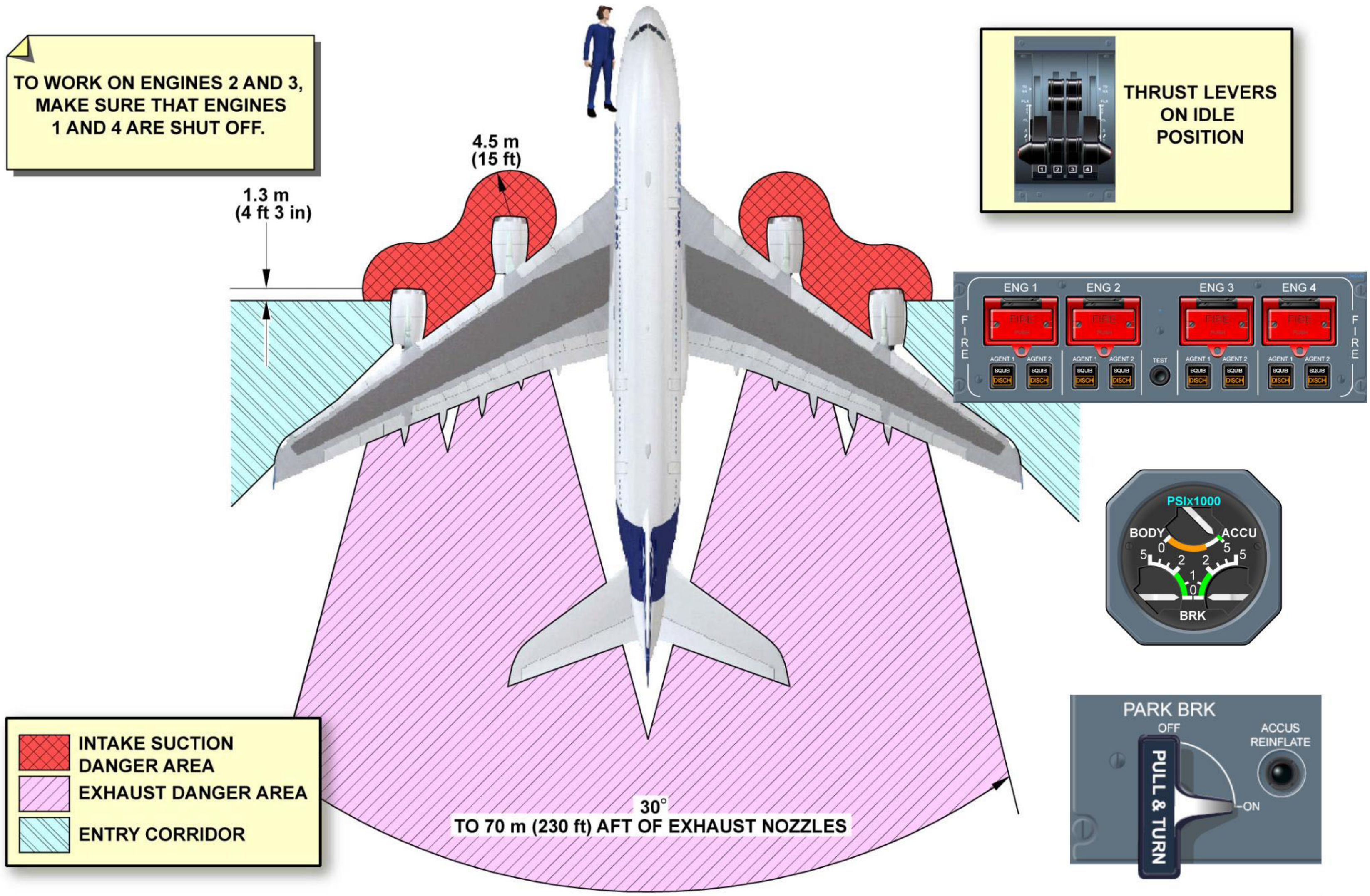
ENGINE CONTROLS AND INDICATION PRESENTATION - THRUST LEVERS & A/THR P/B

L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation

Before Engine Start



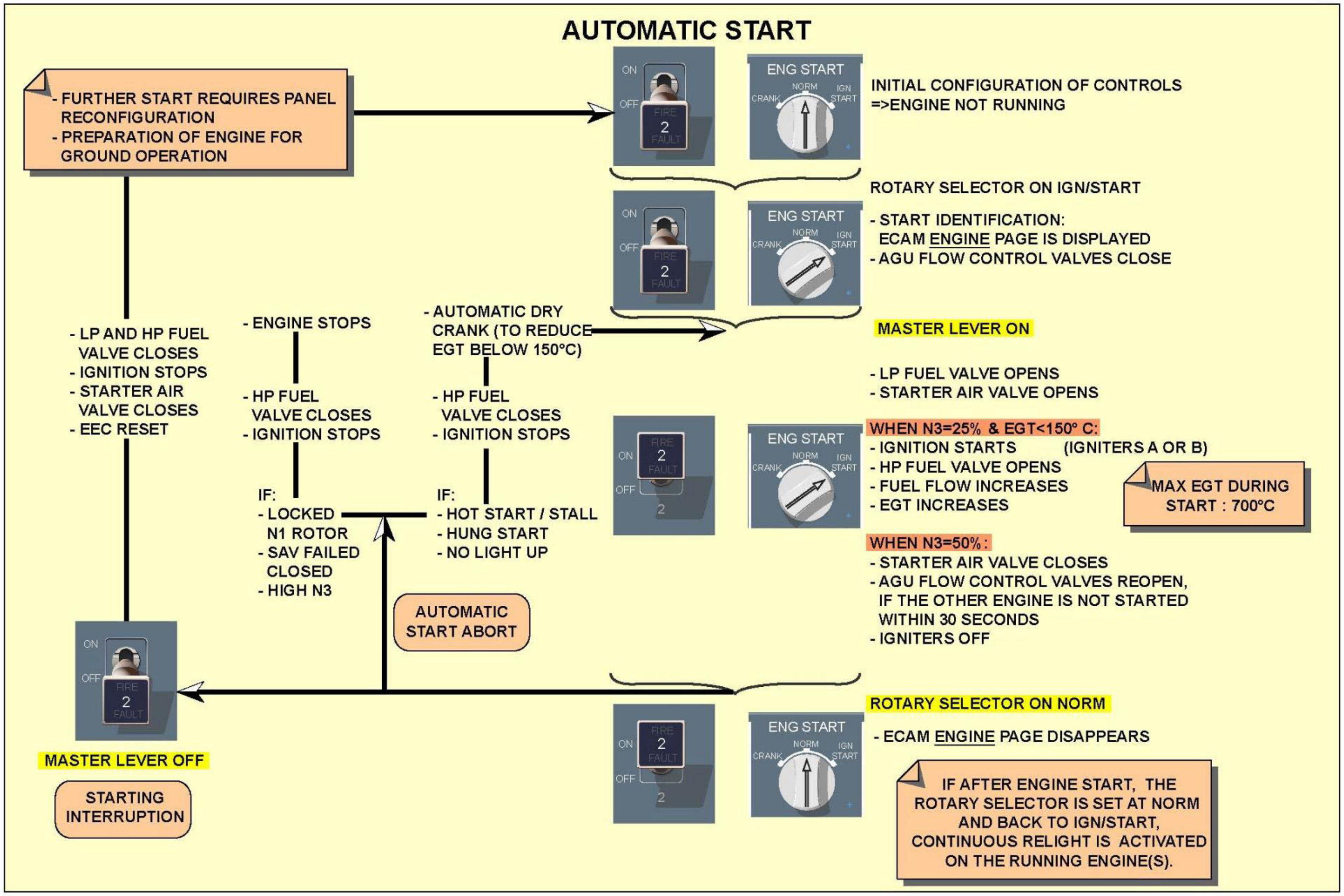
ENGINE OPERATION - BEFORE ENGINE START

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Engine Auto Start

NOTE: Before starting, make sure that the EGT is less than 150 ºC (302 ºF).



ENGINE OPERATION - ENGINE AUTO START

AUTO START

ENGINE OPERATION - ENGINE AUTO START

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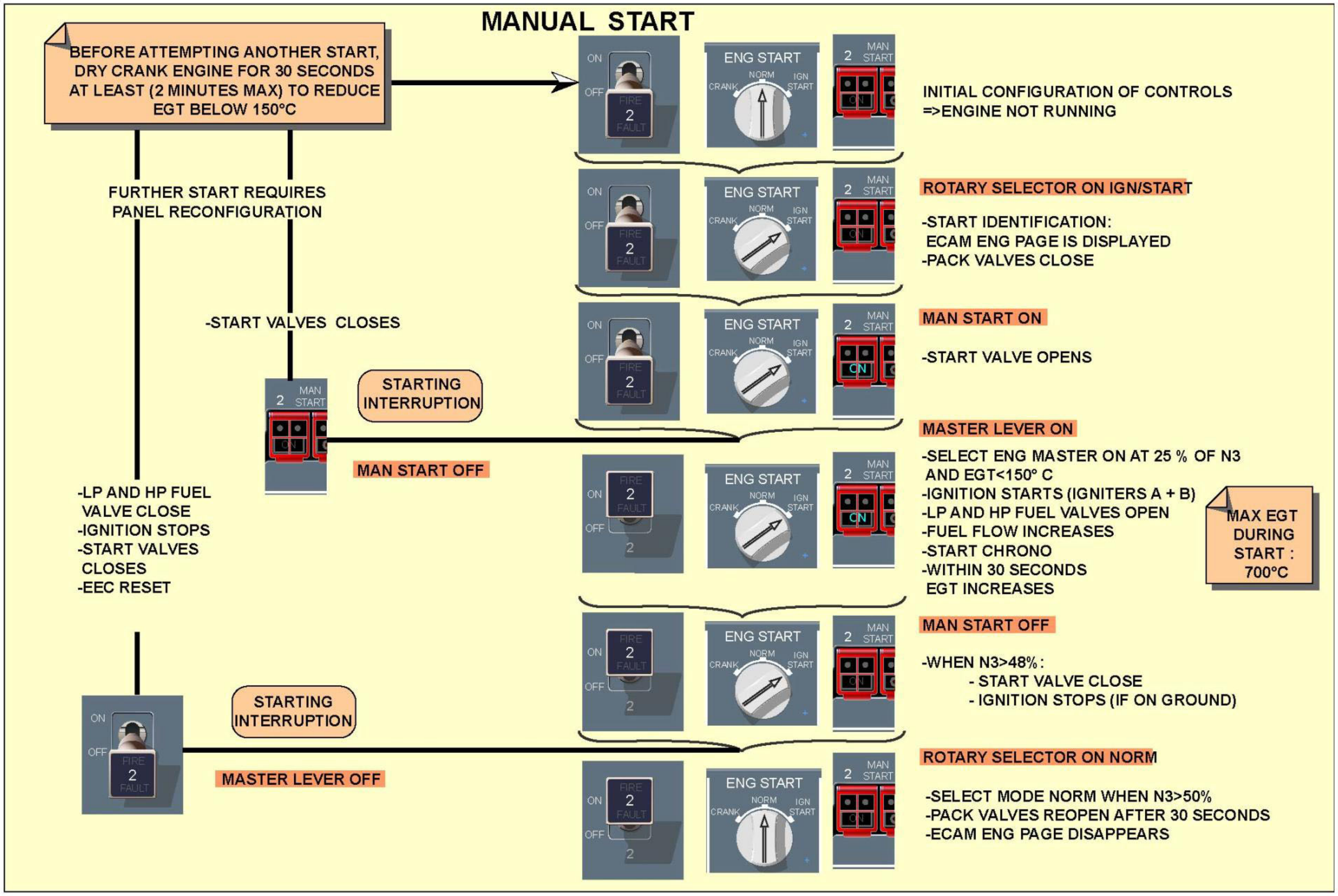
ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Engine Manual Start

NOTE: You must not start the engine if the EGT is more than 150 ºC (302 ºF). If you do, the EGT will pass its limit during the engine start. You can dry motor the engine to decrease the EGT.

CAUTION: MAKE SURE THAT THE EGT IS LESS THAN 150 ºC (302 ºF).



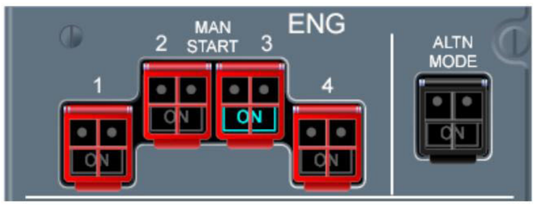
ENGINE OPERATION - ENGINE MANUAL START

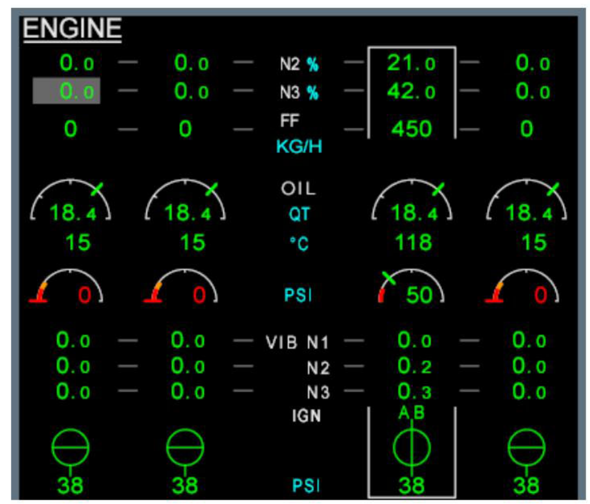
MANUAL START

CAUTION:

- THERE IS NO AUTOMATIC PROTECTION WHILE PERFORMING AN ENGINE START IN MANUAL MODE. WATCH CAREFULLY EGT PARAMETERS.

- ABORT IMMEDIATELY THE START BY THE MASTER LEVER TO OFF, IF EGT TENDS TO OVERSHOOT THE MAX EGT START.





ENGINE OPERATION - ENGINE MANUAL START

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ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Engine Start Faults

NOTE: DURING AUTO START:
- the SAV, FUEL and IGNITERS are commanded off,
- the EEC does a DRY CRANK for a minimum of 20s and until the EGT goes below 150°C,
- a second start attempt is automatically initiated with IGN A and B.
- If the fault is still detected, automatic start is definitively aborted.

DURING MAN START:
- the pilot shuts down the engine, DRY CRANK must be done according to FWC procedure.

FAULT SYMPTOM:

- HOT START

WARNING MESSAGE:

- EGT OVERLIMIT or ENG STALL

CONSEQUENCE:

- EGT HAS REACHED THE MAX **EGT DURING START (700°C).**

FAULT SYMPTOM:

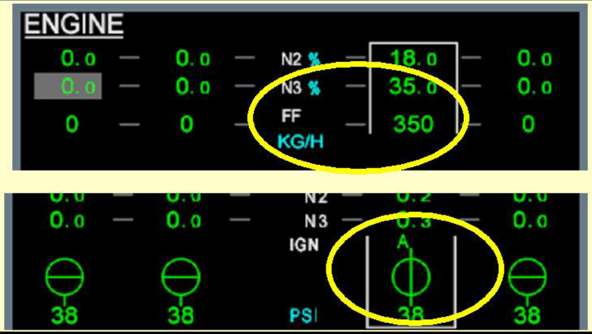
- NO LIGHT UP

WARNING MESSAGE:

- ENG IGN A/B FAULT

CONSEQUENCE:

- Even with **IGN A** or **B** and **Fuel Flow** Indicated, no EGT increase is recognized.



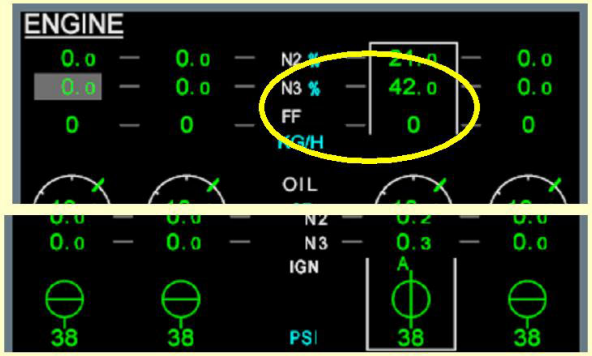
FAULT SYMPTOM: NO FUEL FLOW

WARNING MESSAGE:

- ENG HP FUEL V NOT OPEN

CONSEQUENCE:

- F F indication remains at zero with MASTER LEVER set to ON.
- MASTER LEVER DISAGREE
- MASTER LEVER integrated FAULT light is on.



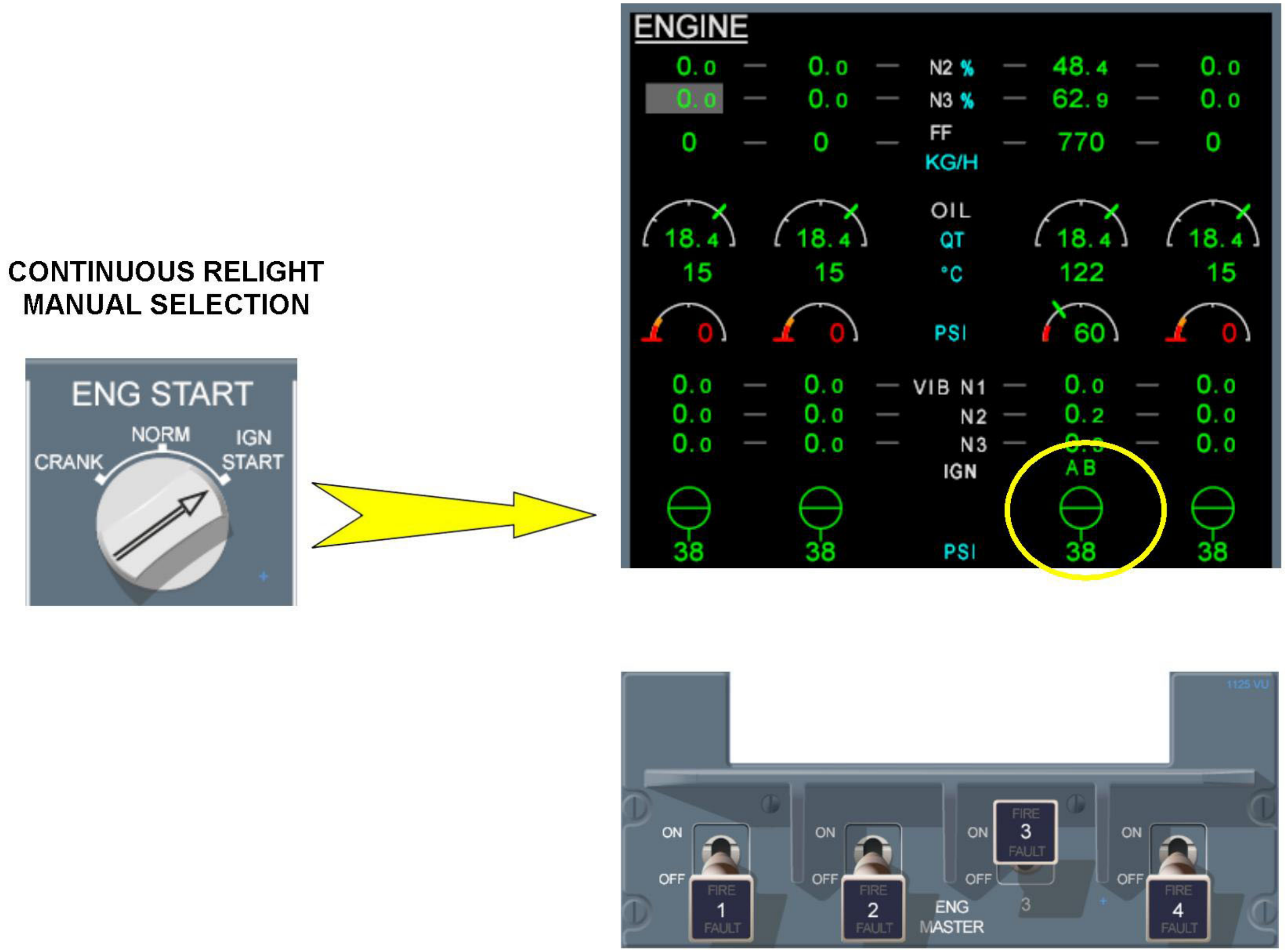
ENGINE OPERATION - ENGINE START FAULTS

L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Continuous Ignition



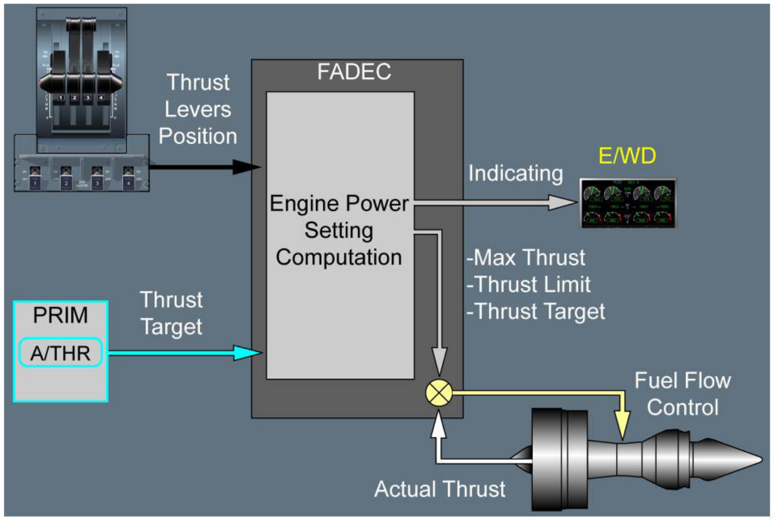
ENGINE OPERATION - CONTINUOUS IGNITION

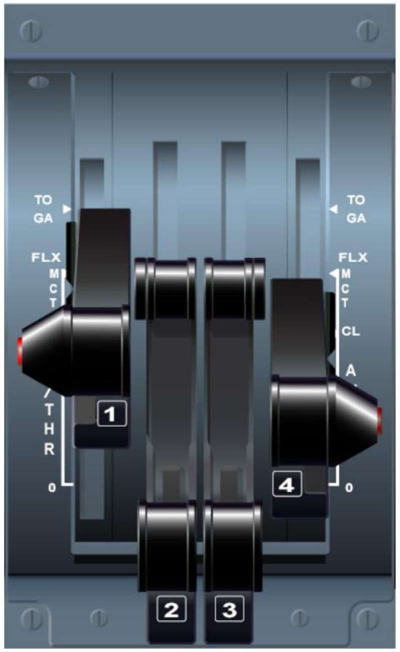
ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

FWD Thrust and Mode Settings

NOTE: The Engine Electronic Controller (EEC) software does not let the engine operate in the 64% to 72% N1 speed range. Thus, speed increase will stop at 64% N1, until the throttle lever is in a position for engine operation at 72% N1. The EEC software will then let the engine accelerate through the 64% to 72% N1 speed range.





- SLOWLY INCREASE POWER OF THE ENGINE TO BE TESTED TO 78% N1.

- AT THE SAME TIME, SLOWLY INCREASE POWER OF THE OPPOSITE ENGINE TO 50% OF POWER, FOR LATERAL BALANCE.

ENGINE OPERATION - FWD THRUST AND MODE SETTINGS

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Thrust Control Faults

FAULT SYMPTOM:

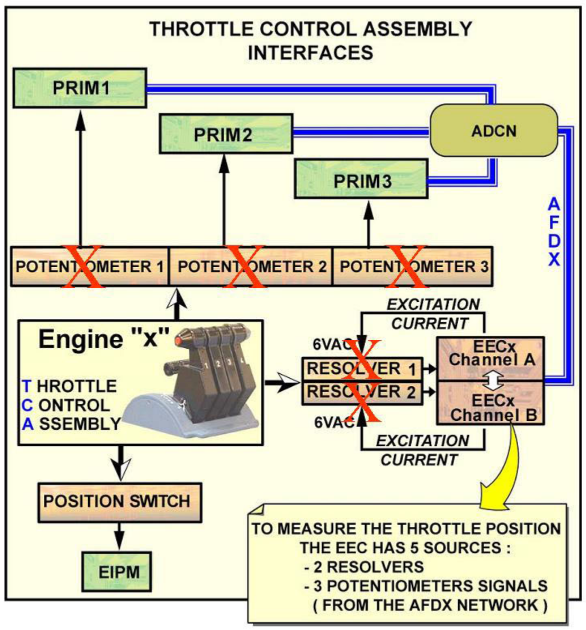
THRUST LEVER ANGLE SIGNAL LOSS

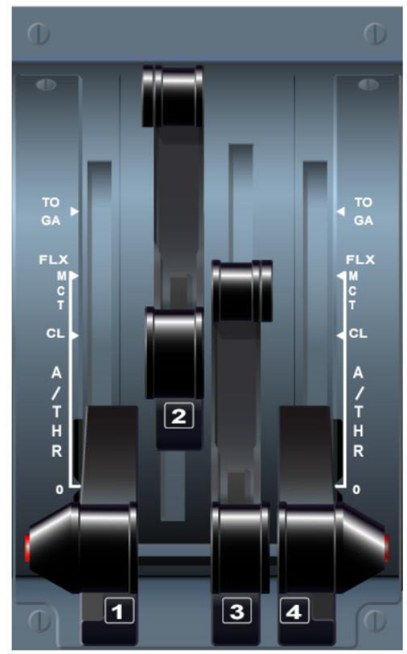
WARNING MESSAGE:

- ENG THRUST LEVER FAULT

CONSEQUENCE:

- THRottle REFerence, cyan circle, corresponding to the THRUST LEVER position does not follow the actual THRUST LEVER position.





ENGINE OPERATION - THRUST CONTROL FAULTS

L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

FAULT SYMPTOM:

-TPR MODE LOSS

WARNING MESSAGE:

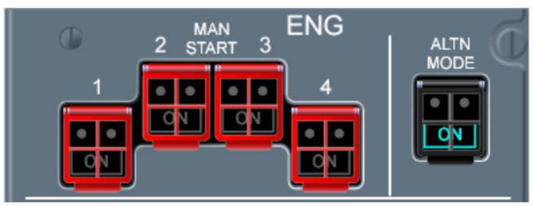
-ENG NORM MODE FAULT

ALTN MODE........ON

CONSEQUENCE:

-The EEC has reverted automatically into N1 RATED MODE.

-Corresponding THR indicator flagged with Amber “XX”.



WITH ALTN MODE P/BSW PRESSED ON, ALL EECs ARE FORCED TO N1 RATED MODE..

L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

ENGINE OPERATION - THRUST CONTROL FAULTS

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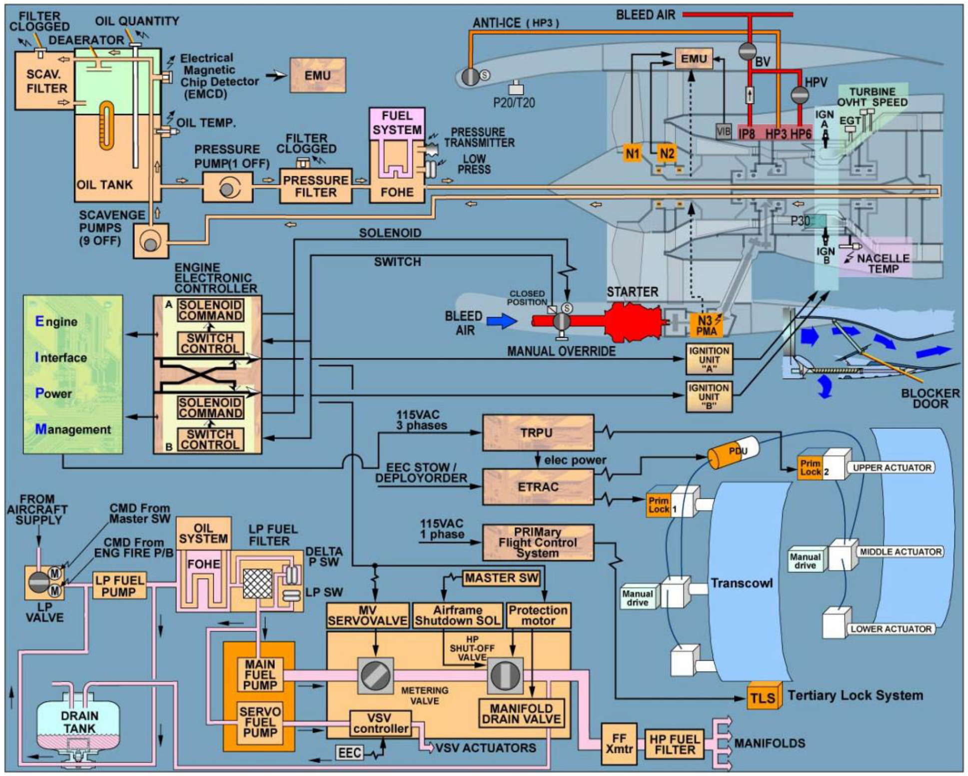
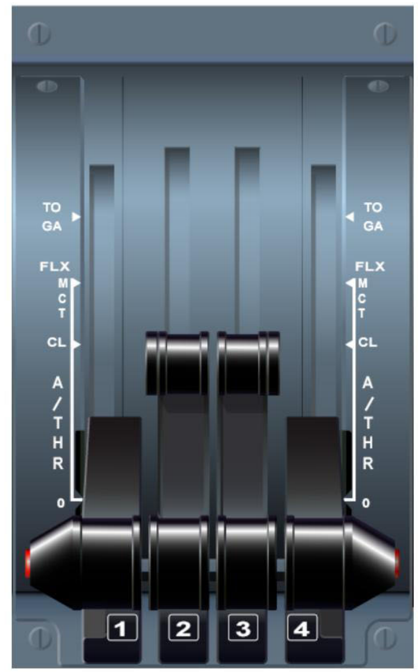
ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Reverse Thrust





ENG 2 AND 3 REVERSE THRUST SET TO IDLE

ENGINE OPERATION - REVERSE THRUST

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Reverser Fault

FAULT SYMPTOM:

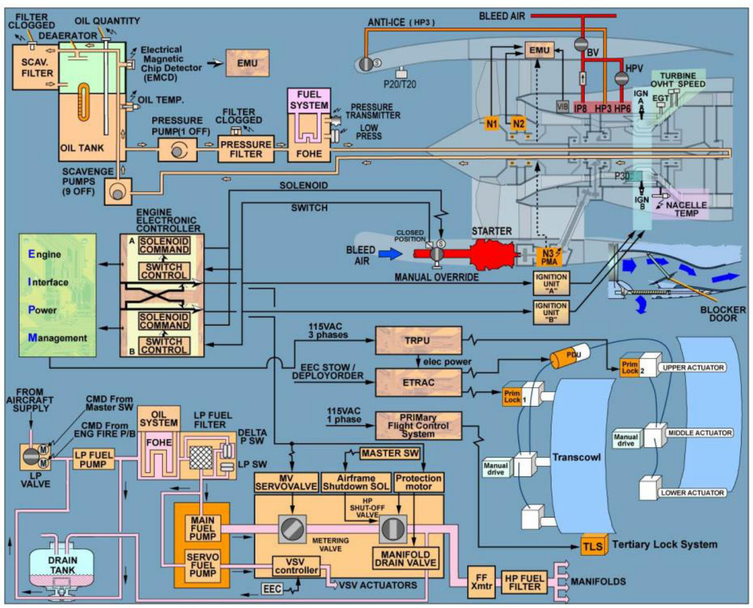
-THRUST REVERSER FAILED UNLOCK

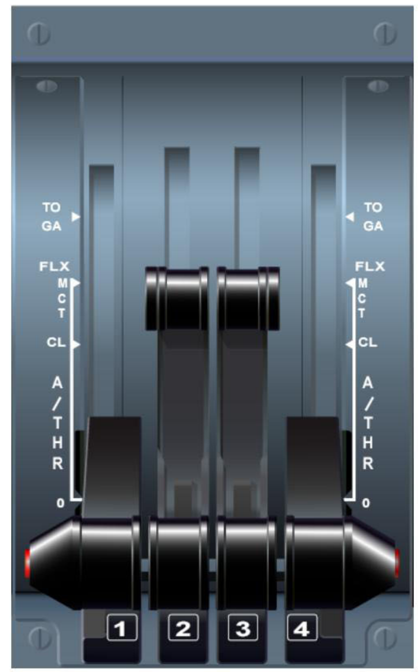
WARNING MESSAGE:

-ENG REV UNLOCKED

CONSEQUENCE:

- REV amber legend remains on the corresponding THR indicator,
- Disagree with its dedicated REVERSE THRUST lever, already in stow position,
- Associated FADEC allows IDLE power only on the ENG.





ENGINE OPERATION - REVERSER FAULT

L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Engine Parameters Faults

CAUTION: YOU MUST NOT OPERATE THE ENGINE IF THE FUEL FILTER IS CLOGGED. CONTAMINATED FUEL CAN BYPASS THE FILTER AND CAUSE DAMAGE TO THE ENGINE. REPLACE THE LP FUEL FILTER BEFORE YOU OPERATE THE ENGINE AGAIN.

FAULT SYMPTOM:

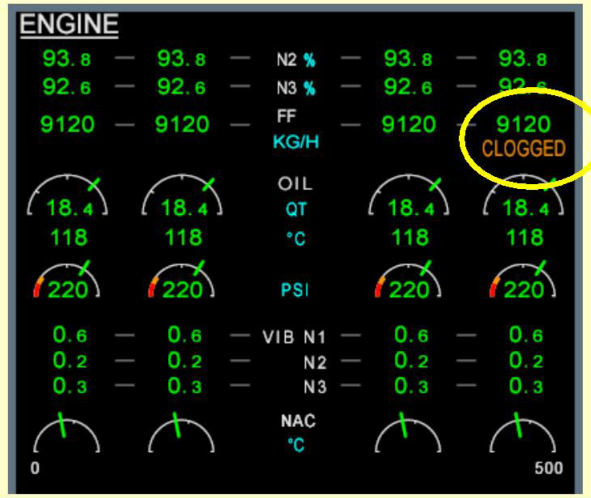
- LP FUEL FILTER CONTAMINATION

WARNING MESSAGE:

- ENG FUEL FILTER CLOGGED

CONSEQUENCE:

- **CLOGGED** indication appears in amber under the Fuel Flow indication.
- Fuel filter inspection and change required before next flight.



FAULT SYMPTOM:

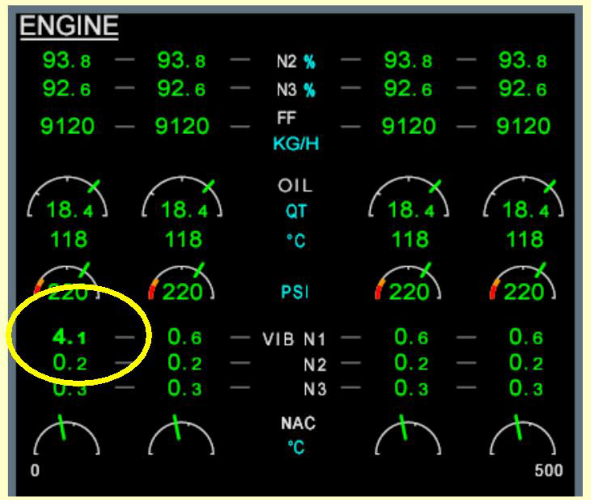
-HIGH N1 VIBRATION

ADVISORY:

- N1 vibration indication pulses green

CONSEQUENCE:

- ECAM Advisory, If N1 vibrations level is reached (2.8 Cockpit Unit),
- Engine fan unbalance,
- Compressor rumble noises could be heard.



ENGINE OPERATION - ENGINE PARAMETERS FAULTS

FAULT SYMPTOM:

IP TURBINE DISK OVERHEAT

WARNING MESSAGE:

- ENG TURBINE OVHT

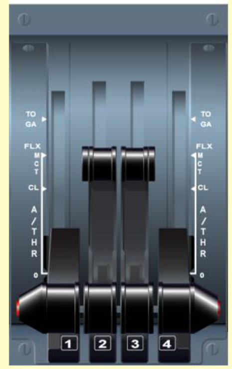
CONSEQUENCE:

- Air temperature around the IP turbine disk increases,

-The EGT could increase, but below over limit of 850°C,

- Reduce THRUST LEVER to Idle stop,

- If the fault occurs on the ground, Initiate an Engine shutdown to avoid damage of IP Turbine.



FAULT SYMPTOM:

- ABNORMAL OIL PRESSURE DROP

WARNING MESSAGE:

- ENG OIL PRESS LO

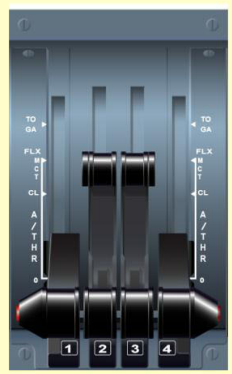
CONSEQUENCE:

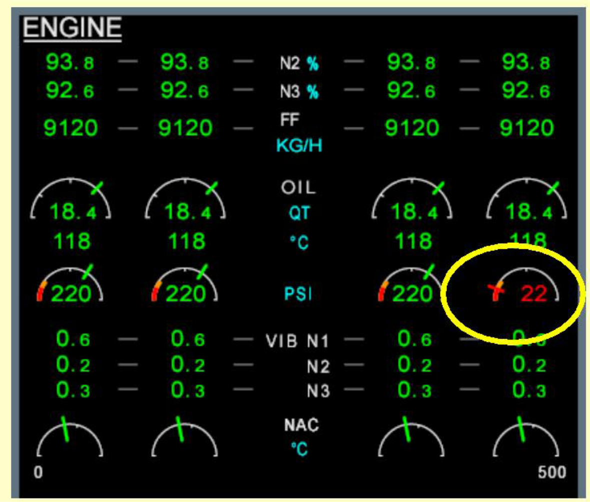
- The oil pressure quadrant shows a low pressure value.

If the oil pressure reduces below red line limit (25 psi):

- Reduce THRUST LEVER to Idle stop,

- Initiate an engine shutdown, to avoid engine damage.





ENGINE OPERATION - ENGINE PARAMETERS FAULTS

L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

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ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Engine Shut Down

CAUTION: BE SURE THAT AN AIR BLEED SOURCE IS ALWAYS AVAILABLE EITHER FROM APU, ENGINE BLEED OR EXTERNAL PNEUMATIC GROUND CART BEFORE YOU SHUT DOWN THE ENGINE.
THIS IS IN THE CASE OF AN INTERNAL FIRE OR ENGINE TAILPIPE FIRE EMERGENCY PROCEDURE.

CAUTION: DO NOT OPERATE THE AGENT DISCHARGE PUSHBUTTON. IT IS ONLY NECESSARY TO ARM THE FIRE EXTINGUISHER SYSTEM.

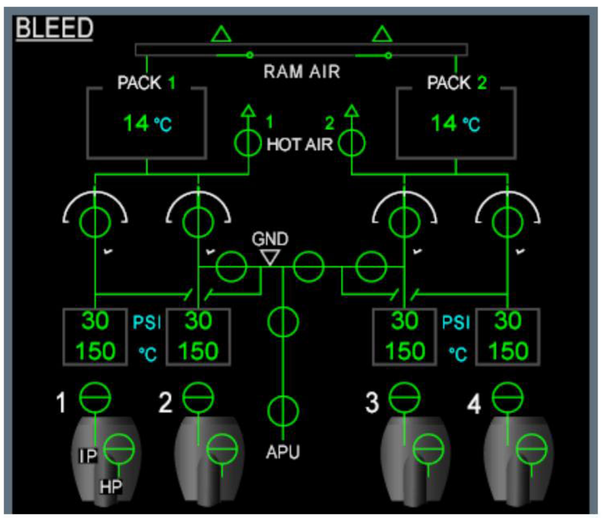
CAUTION: BE SURE THAT AN AIR BLEED SOURCE IS ALWAYS AVAILABLE EITHER FROM APU, ENGINE BLEED OR EXTERNAL PNEUMATIC GROUND CART, BEFORE YOU SHUT DOWN ENGINE. THIS IS IN THE CASE OF AN INTERNAL FIRE OR ENGINE TAILPIPE FIRE; EMERGENCY PROCEDURE HAS TO BE APPLIED.

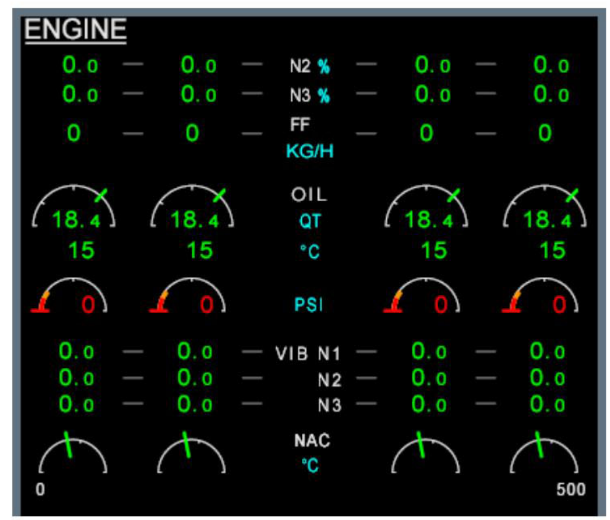
NORMAL SHUT DOWN:

Make sure that the FF is at zero and N1/N2/N3 speeds decrease correctly after you set the MASTER LEVER to the OFF position.

If the engine speeds do not decrease, the Hydro mechanical Unit (HMU) - Shut-Off Valve (SOV) has a failure. In this case, push the ENGINE FIRE PB to isolate the aircraft systems.

CAUTION: THE FIRE PUSHBUTTON WILL ARM THE FIRE EXTINGUISHERS. DO NOT OPERATE THE AGENT DISCHARGE PUSHBUTTON.



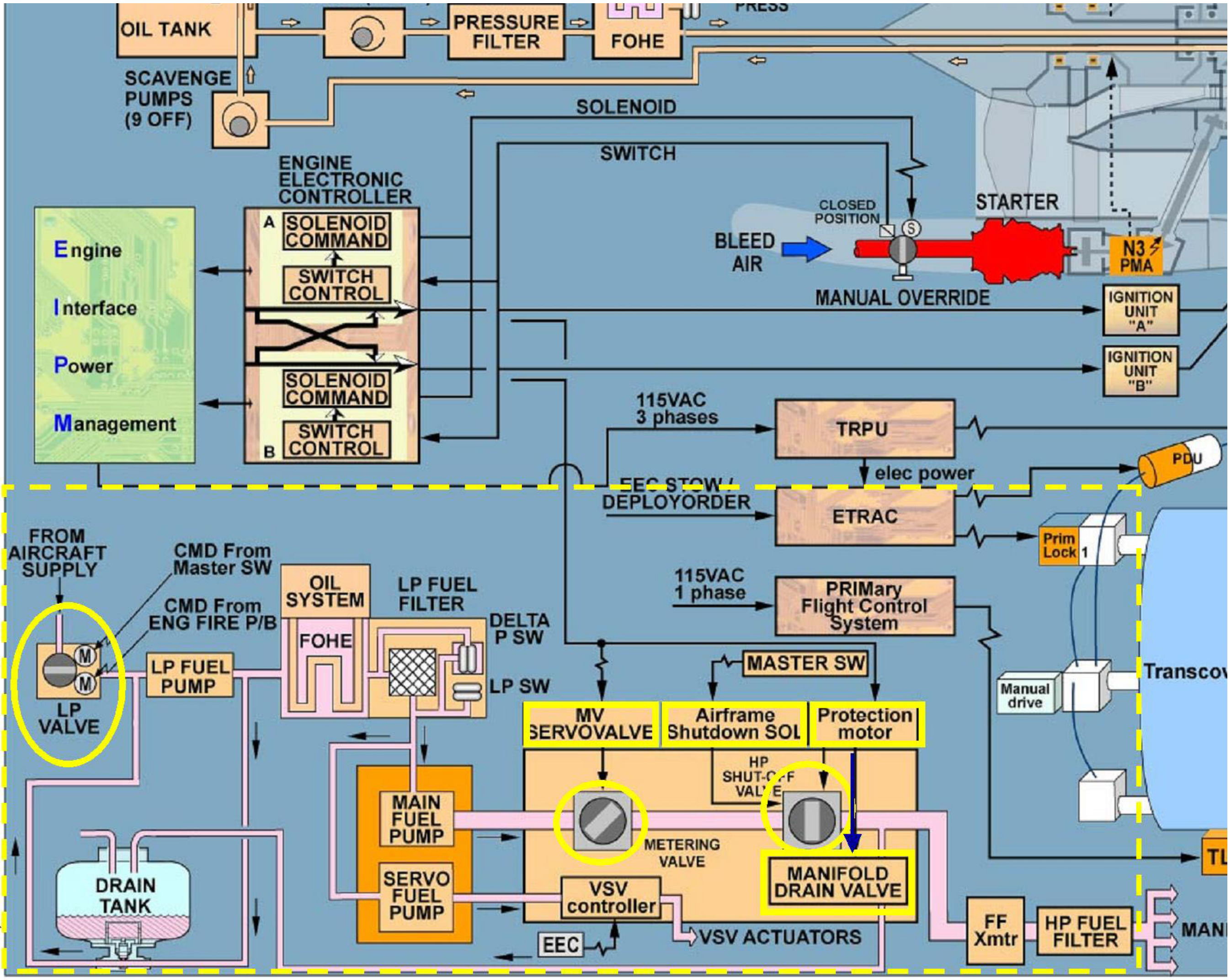


ENGINE OPERATION - ENGINE SHUT DOWN

L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

MASTER LEVER TO OFF CONTROL SIGNAL:

- The MASTER LEVER controls directly the LP fuel SOV and HP Fuel SOV.
- Following MASTER LEVER OFF input signal, the EEC commands METERING VALVE to close and initiates the PROTECTION MOTOR self-test.
- On ground only, the PROTECTION MOTOR self-test provides the Fuel Manifolds drainage to the Drain Collector Tank.



ENGINE OPERATION - ENGINE SHUT DOWN

L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

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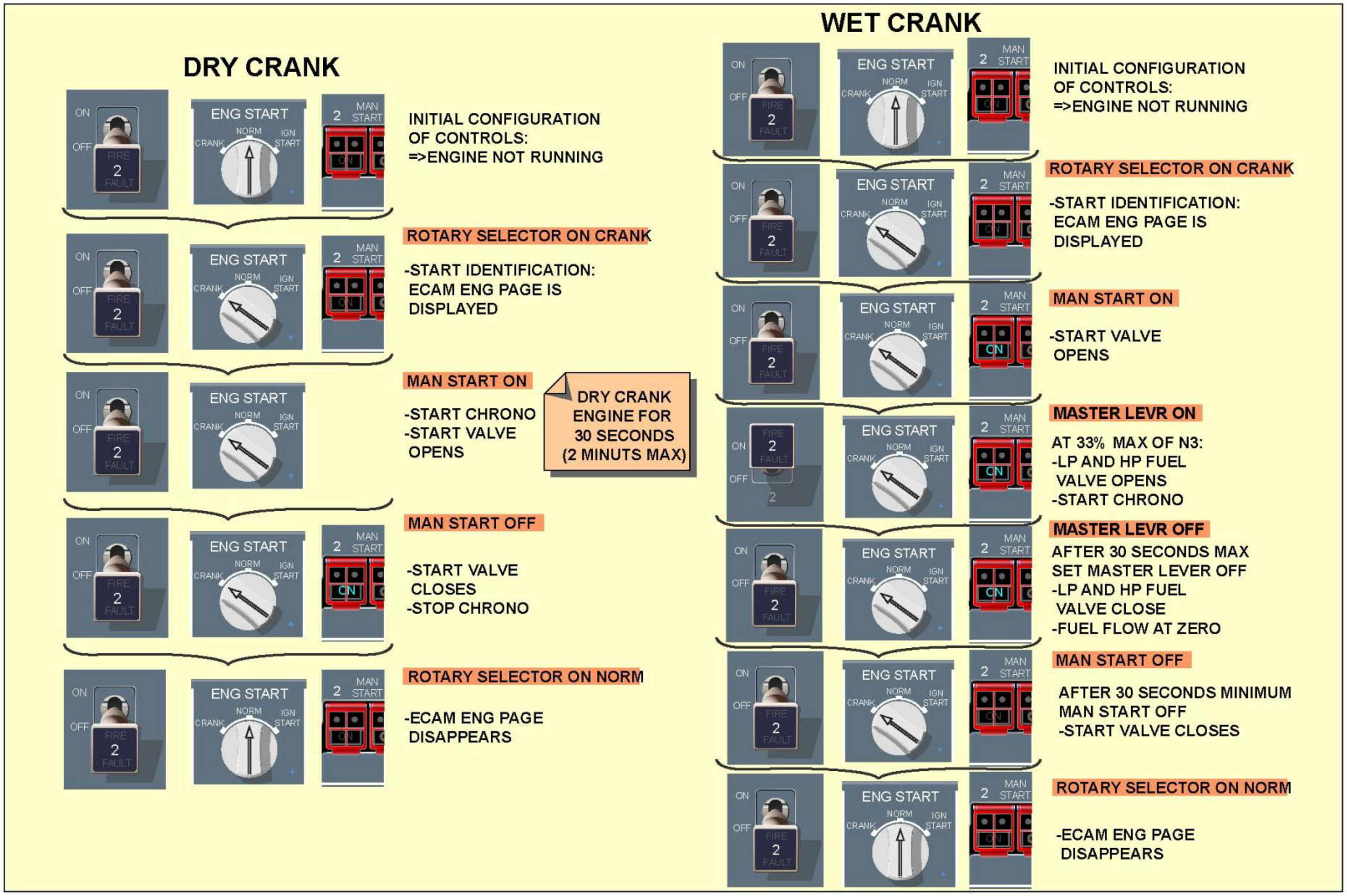
ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Dry and Wet Motorings

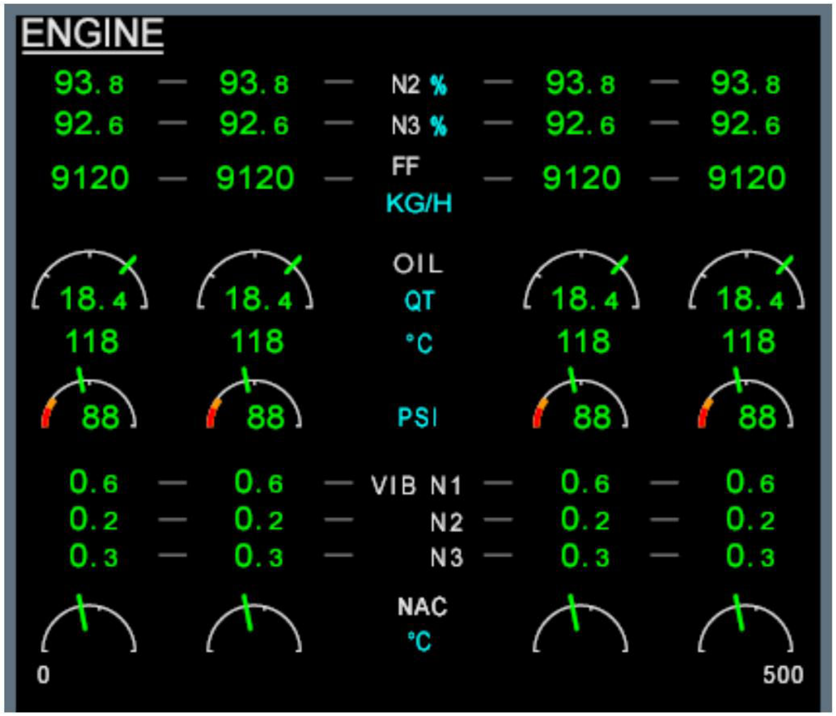


ENGINE OPERATION - DRY AND WET MOTORINGS

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Engine Operation (continued)

Engine Operation Limits Summary



ENGINE OPERATION - ENGINE OPERATION LIMITS SUMMARY

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

OMS Pages

Access Procedure

EEC Menus

CAUTION: WHEN YOU SET THE CONTROLS AS SPECIFIED IN THE PROCEDURE DISPLAYED ON THE OMS, THE DRY CRANK WILL START IMMEDIATELY.

CAUTION: THE P20T20 PROBE WILL BE ENERGIZED FOR 5 SECONDS AND GETS HOT DURING THIS TEST. MAKE SURE THAT NOT COVER, CAP OR PLUG IS INSTALLED ON THE P20T20 PROBE.

CAUTION: WHEN YOU SET THE CONTROLS AS SPECIFIED IN THE PROCEDURE DISPLAYED ON THE OMS, THE DRY CRANK WILL START IMMEDIATELY. IN THIS TEST YOU MUST LOOK TO SEE IF THE HYDRAULIC PRESSURE INCREASES AND DECREASES AT THE APPLICABLE TIMES.

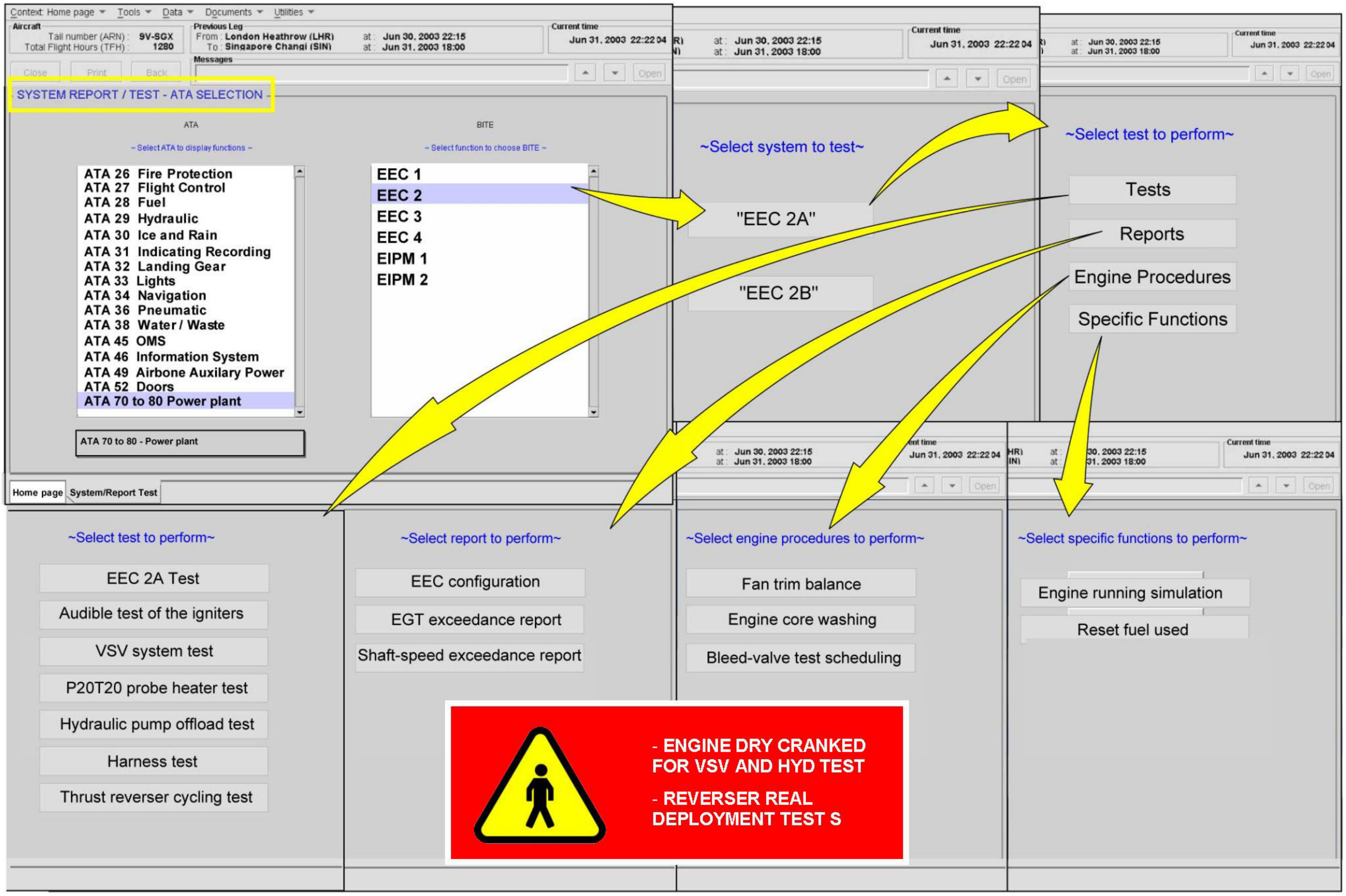
NOTE: This test is only provided on the EEC of the inboard engines.

WARNING: THRUST REVERSER WILL BE ENERGIZED AND MOVE DURING THE TEST. MAKE SURE THAT THE THRUST REVERSER AREA IS CLEAR AND CLEAN OF PERSONS AND TOOLS OR OTHER ITEMS.
MAKE SURE THAT THE THRUST REVERSER IS NOT IN INHIBITED POSITION, MOVE THROTTLE LEVER TO REVERSE IDLE WITHIN 50 SECONDS, THEN MOVE THROTTLE LEVER TO FORWARD IDLE WITHIN 50 SECONDS.

Human factor point:

CAUTION: THE ENGINE IS STARTED TO PROVIDE THE AIR PRESSURE TO OPERATE THE BLEED VALVES WHEN COMMANDED BY THE EEC.

NOTE: Notice that it is the engine run discrete signal simulation. The engine is not started for this test.



OMS PAGES - ACCESS PROCEDURE & EEC MENUS

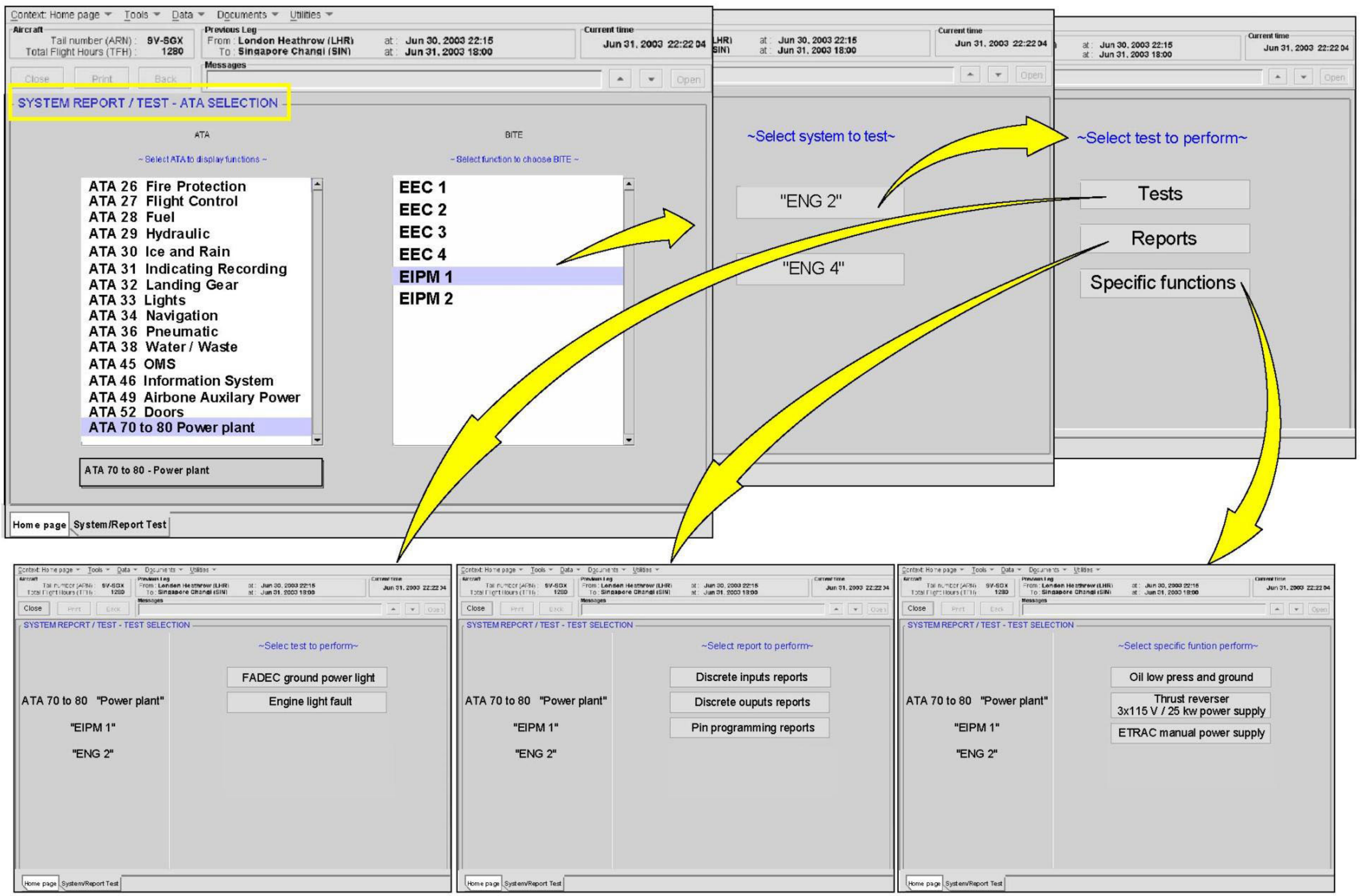
ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

OMS Pages (continued)

EIPM Menus

WARNING: REVERSE SECOND LINE OF DEFENSE WILL BE DEACTIVATED, BE CAREFUL TO POSSIBLE REVERSE DOORS ACTIVATION.

WARNING: ETRAC WILL BE POWER SUPPLIED, BE CAREFUL TO POSSIBLE REVERSE DOORS ACTIVATION.



OMS PAGES - EIPM MENUS

ENGINE & FADEC SYSTEMS OPERATION, CTL & IND (3)

Leaving Aircraft

LEAVING AIRCRAFT

L1W06161 - L0KT0T0 - LM7RO2LEVEL0301

ENGINE CTL/INDICATING & FADEC SYS COMP. LOC. (3)

Engine FADEC Components (Without Fuel)

A/C Zone 400 - P20, P30, DEP and Speed Probes

A/C Zone 120 & 210 - EIPMU, and SSPC

NOTE: Cockpit and avionics compartment

Engine Indicating Components

A/C Zone 400 - Thermocouples, Vibration and EMU

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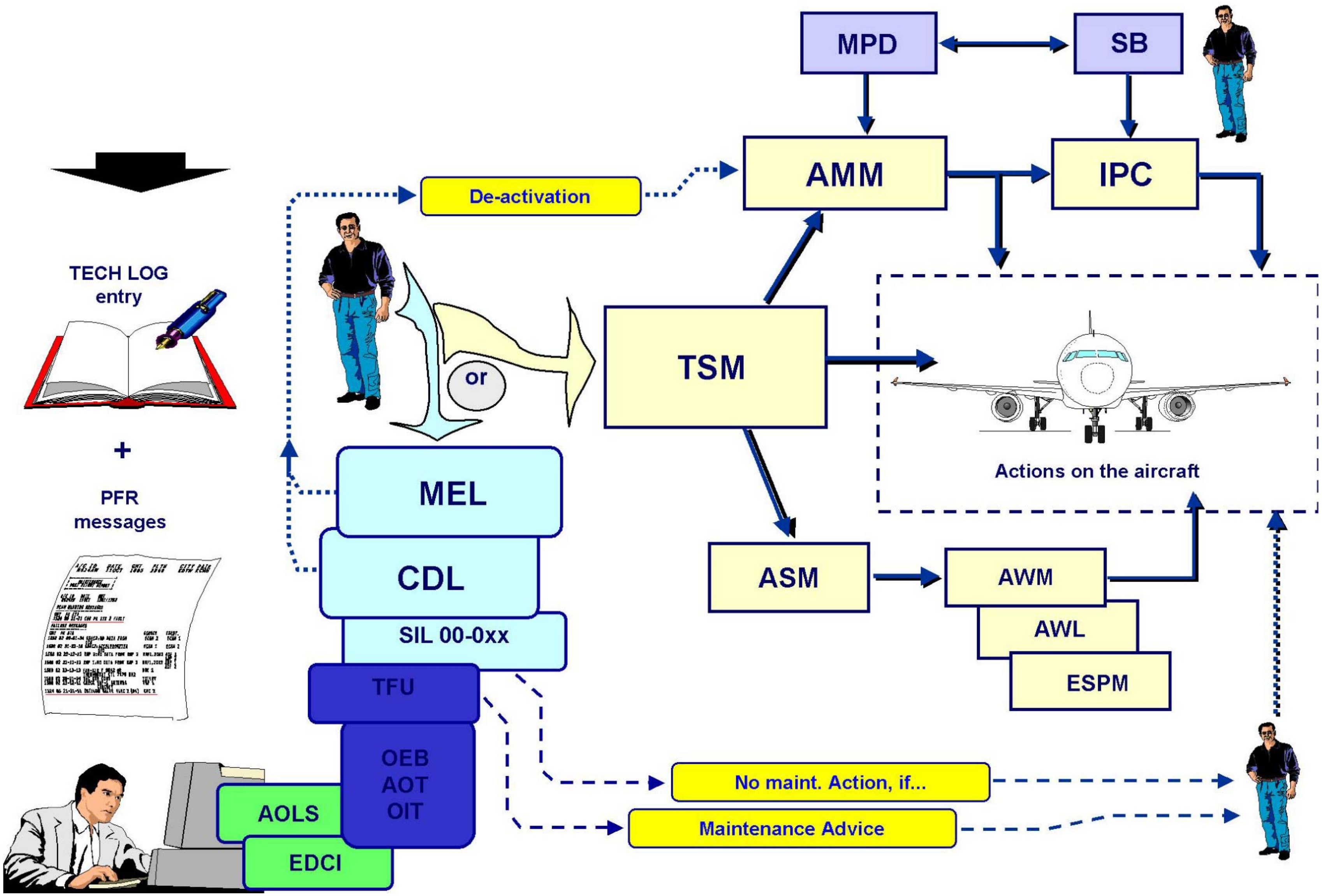
DOCUMENTATION-WIRING REPAIR (3)

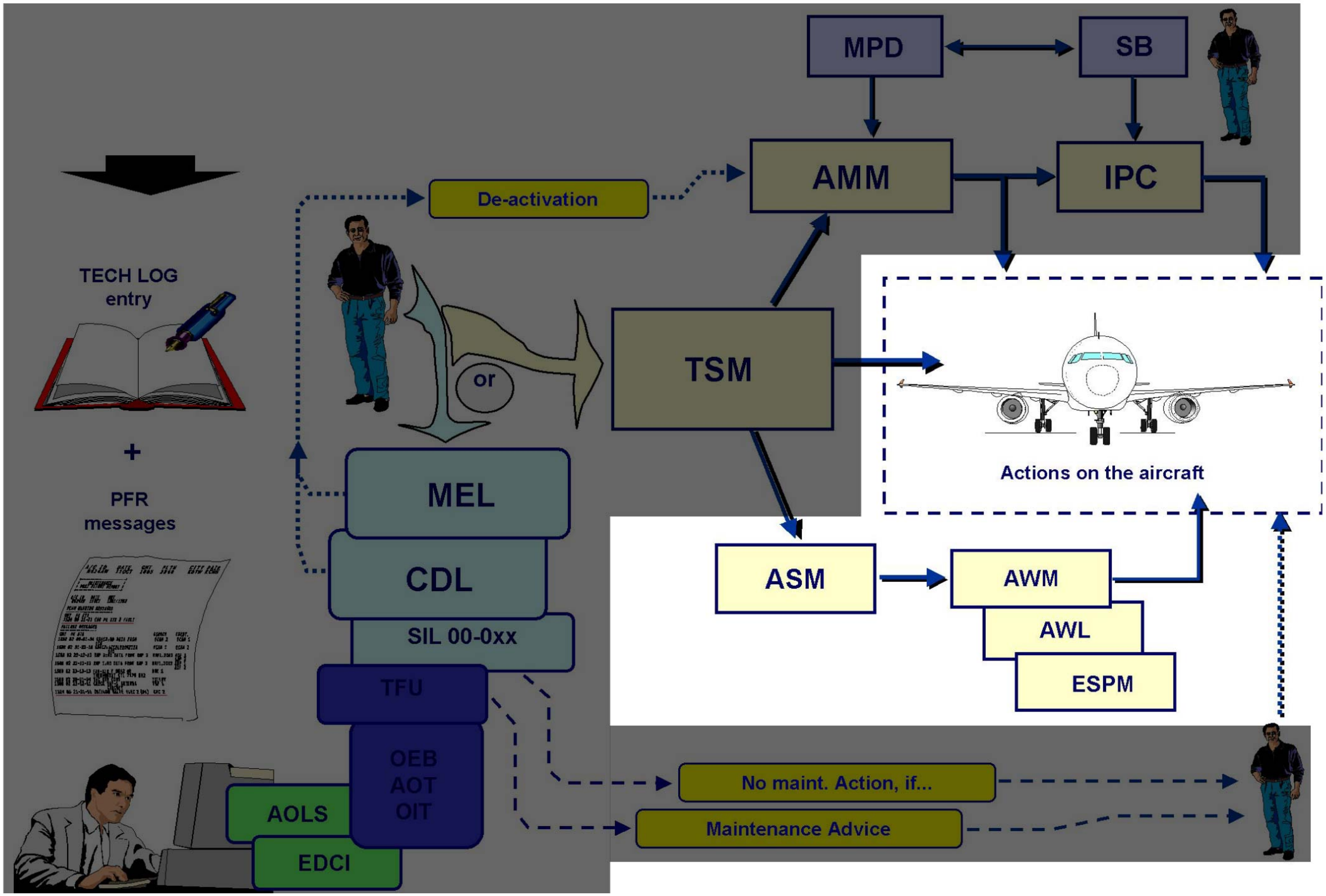
General


MPD
SB
AMM
IPC
De-activation
TECH LOG
entry
or
TSM
Actions on the aircraft
+
PFR
messages
MEL
CDL
SIL 00-0xx
ASM
AWM
AWL
ESPM
TFU
OEB
AOT
OIT
AOLS
EDCI
No maint. Action, if...
Maintenance Advice

GENERAL

DOCUMENTATION-WIRING REPAIR (3)

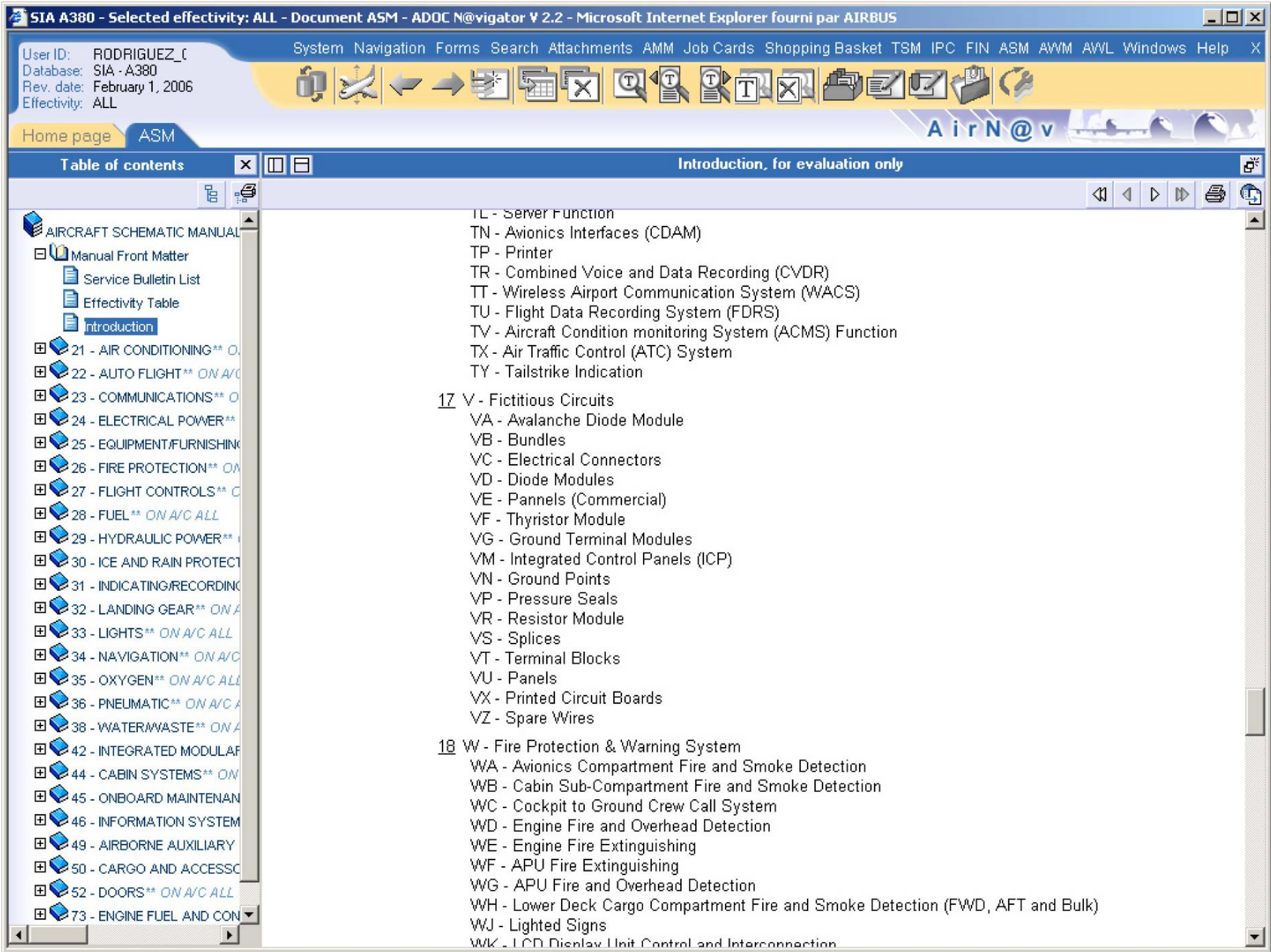
Wiring Repair Documentation Philosophy



WIRING REPAIR DOCUMENTATION PHILOSOPHY

DOCUMENTATION-WIRING REPAIR (3)

ASM Presentation

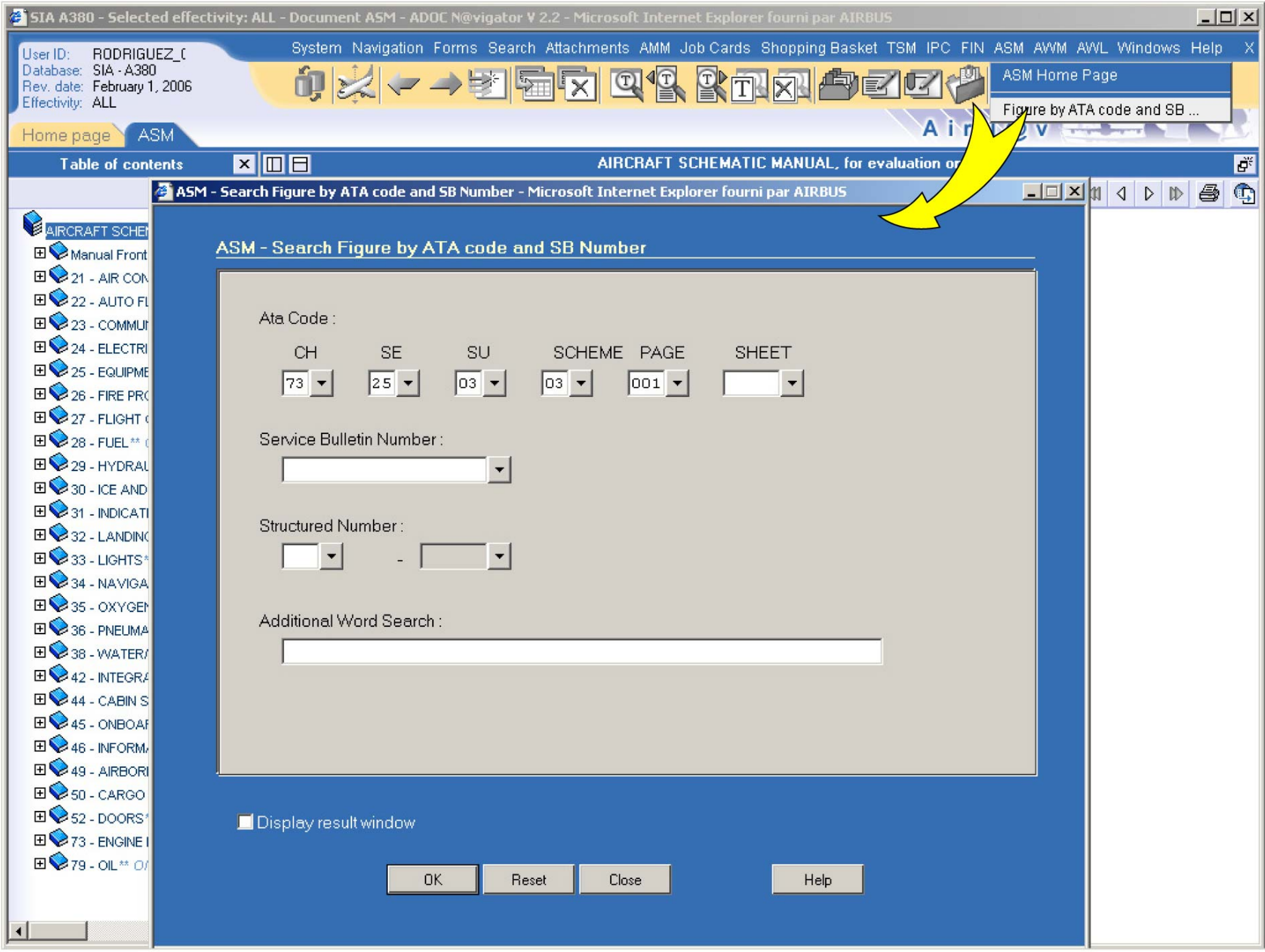


ASM PRESENTATION

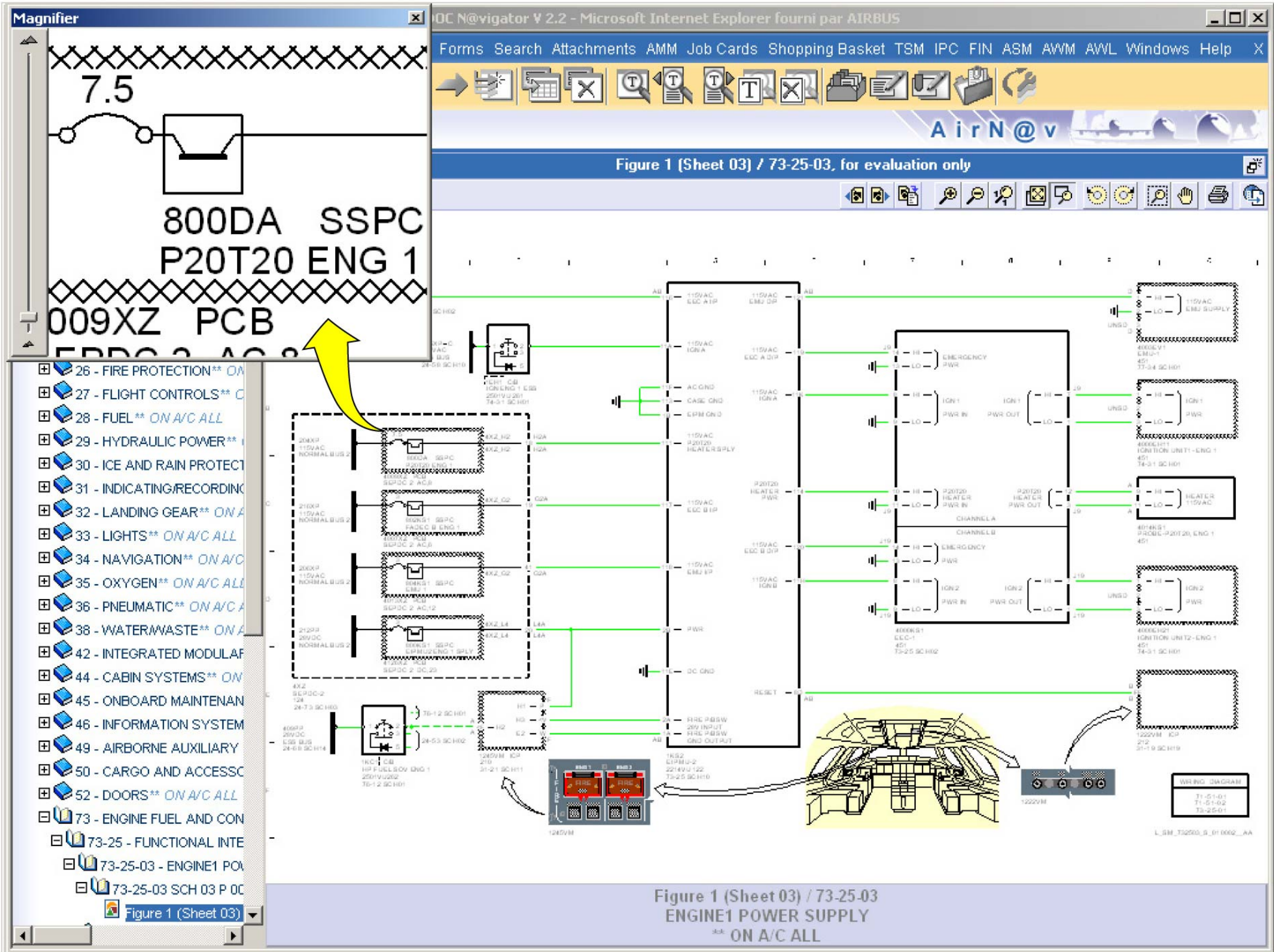
DOCUMENTATION-WIRING REPAIR (3)

ASM Presentation (continued)

ASM Navigation



ASM PRESENTATION - ASM NAVIGATION



ASM PRESENTATION - ASM NAVIGATION

L1W06161 - L0KT0T0 - LM00O3LEVEL0301

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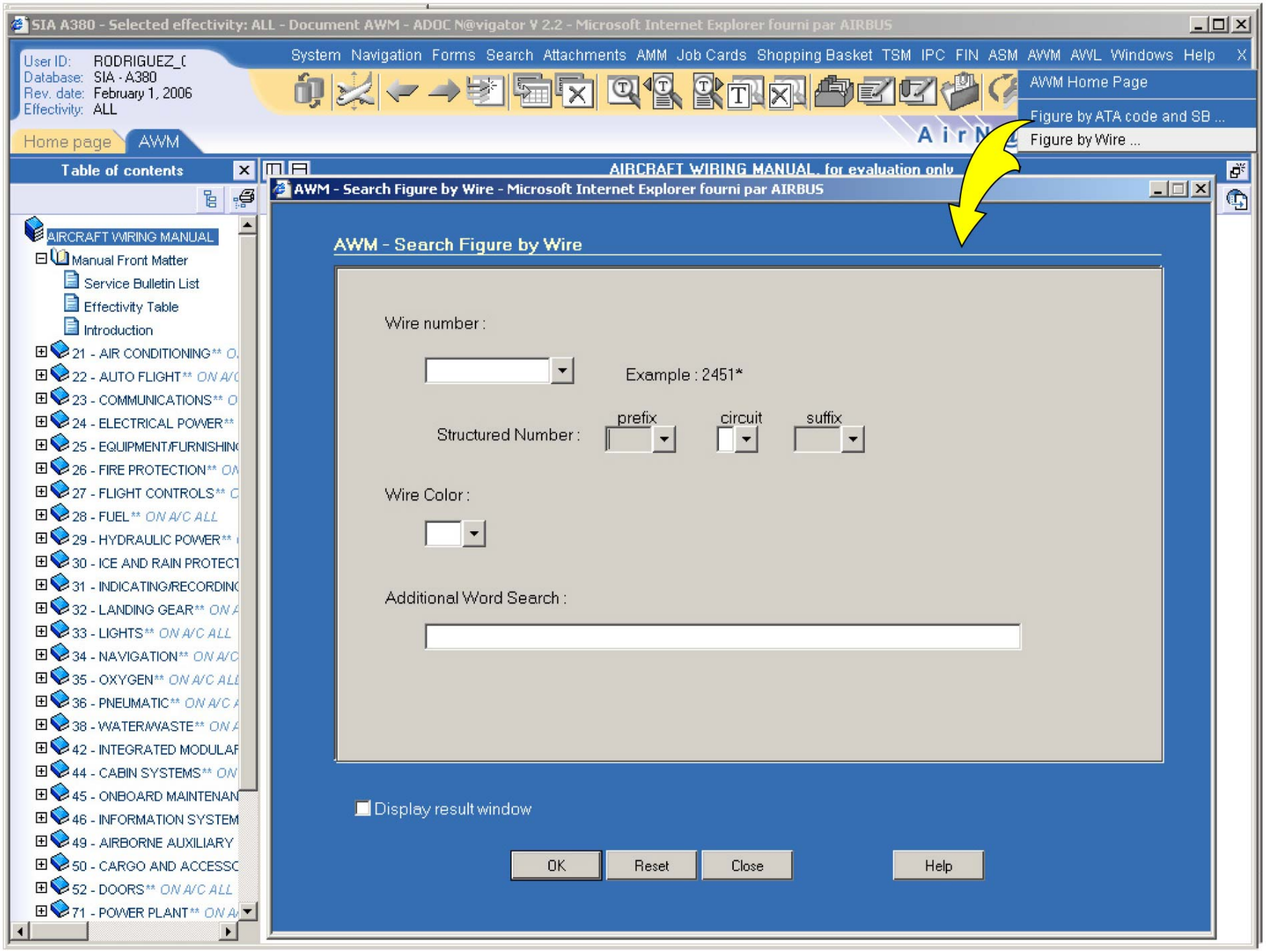
DOCUMENTATION-WIRING REPAIR (3)

AWM Presentation



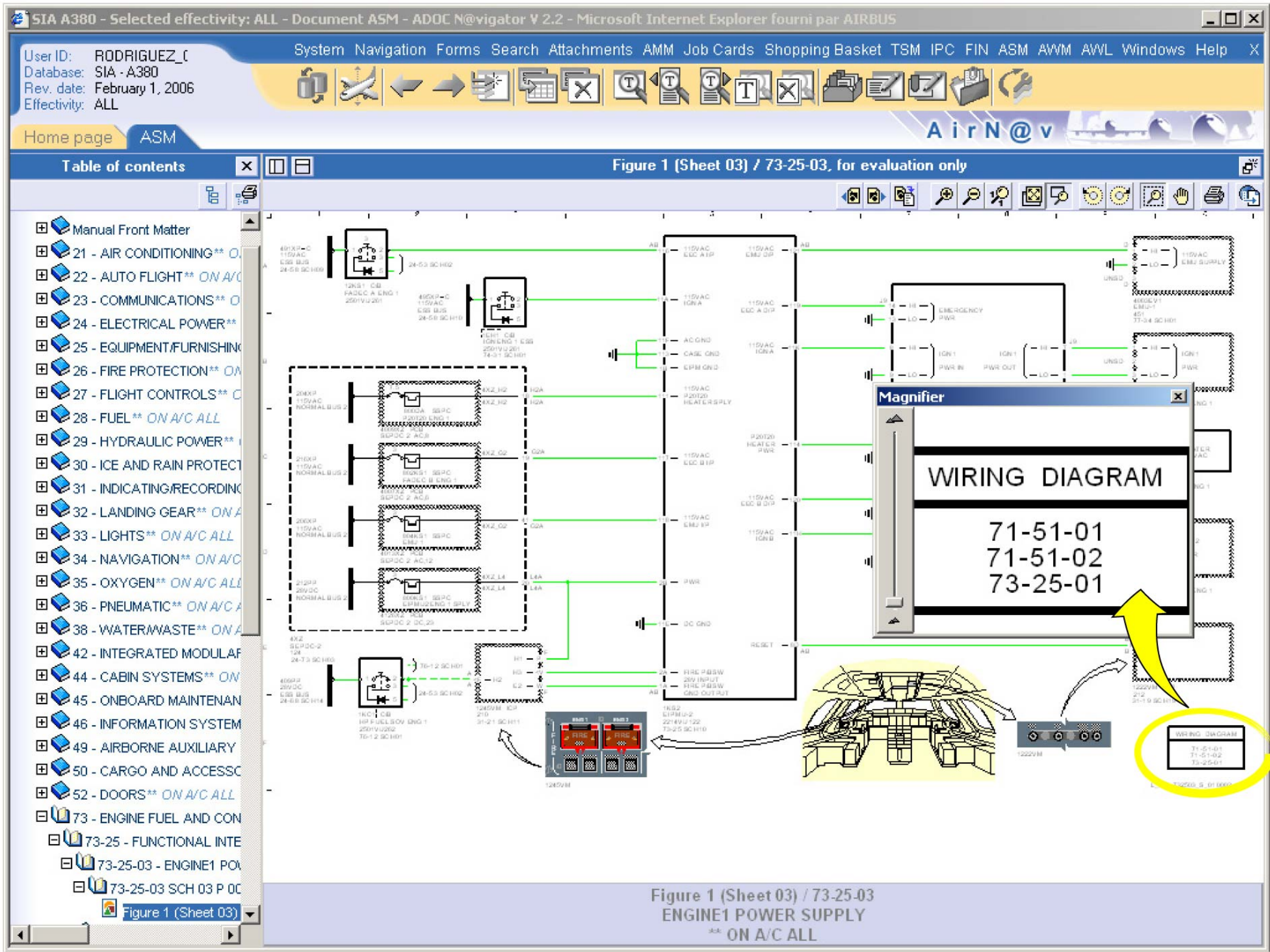
AWM PRESENTATION

L1W06161 - L0KT0T0 - LM00O3LEVEL0301

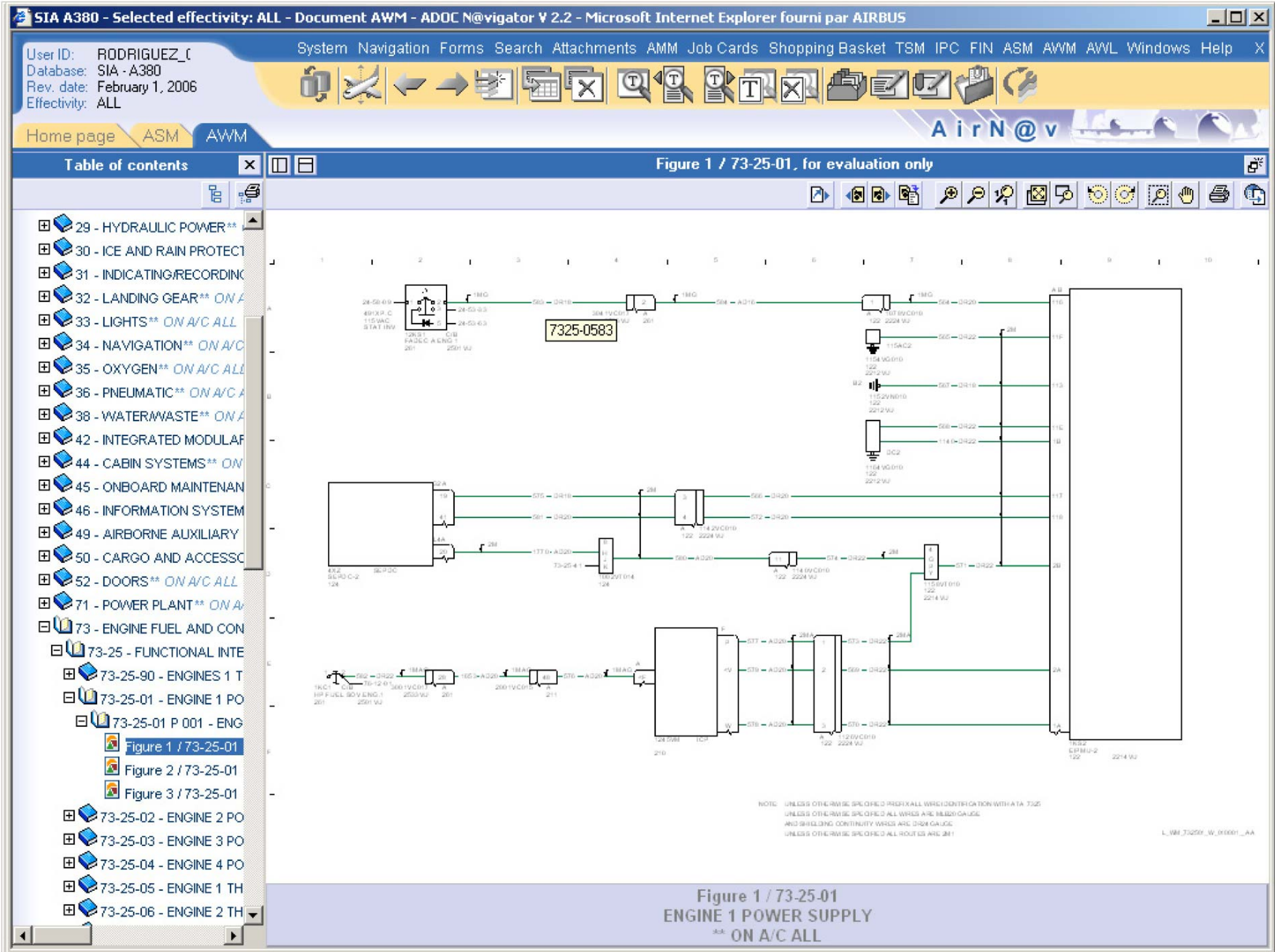
DOCUMENTATION-WIRING REPAIR (3)

AWM Presentation (continued)

Navigation



AWM PRESENTATION - NAVIGATION



AWM PRESENTATION - NAVIGATION

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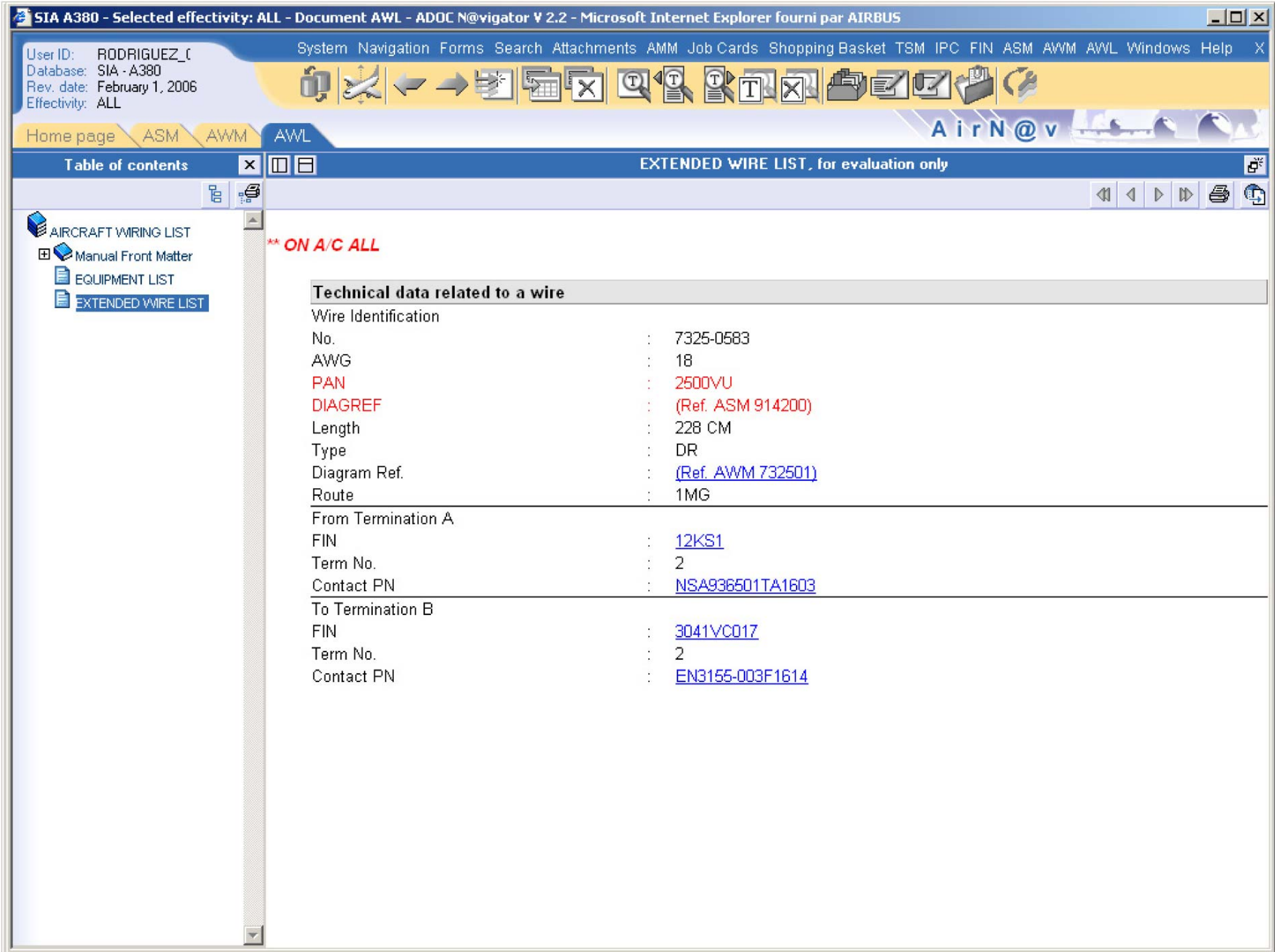
DOCUMENTATION-WIRING REPAIR (3)

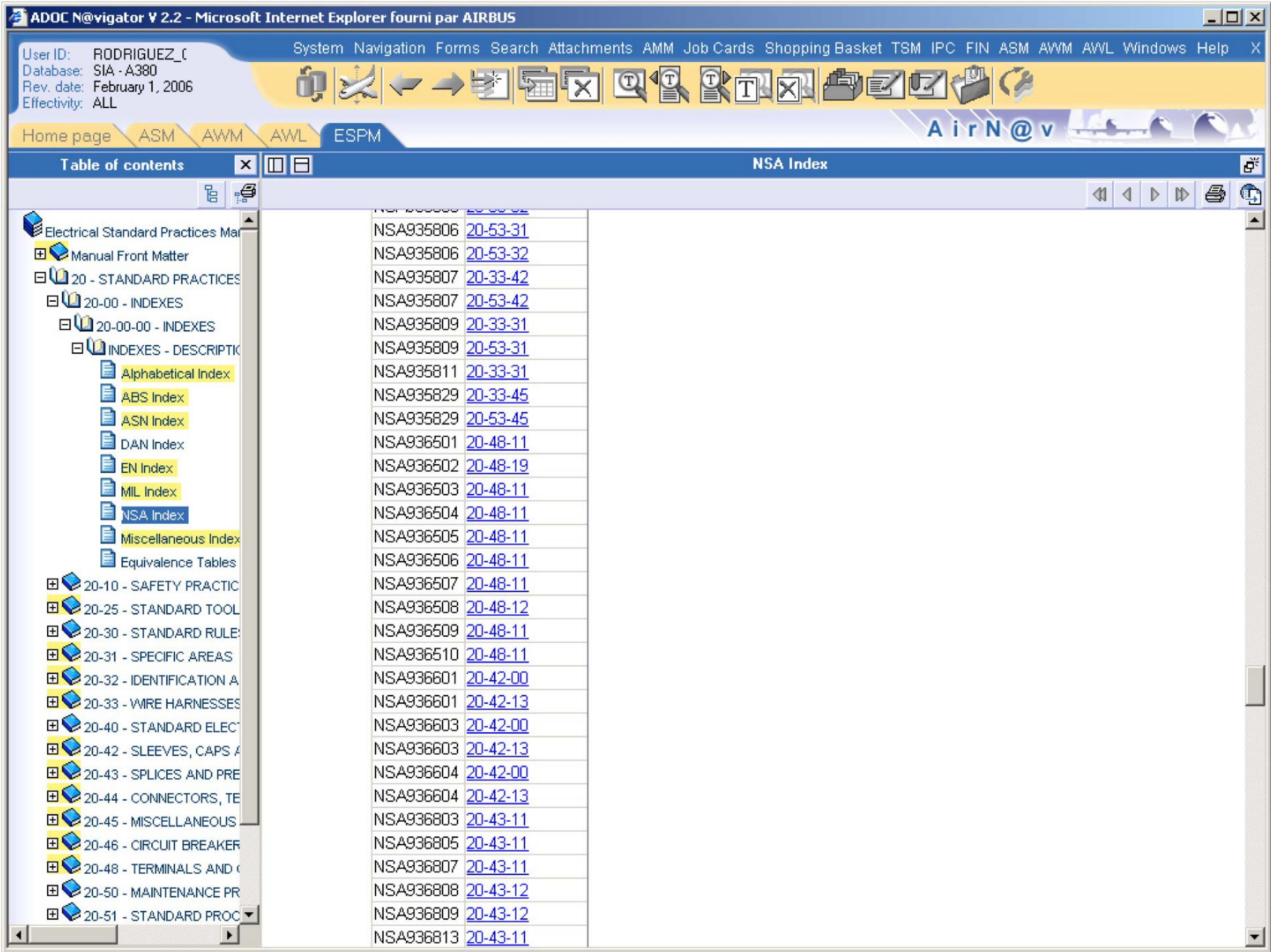
AWL Presentation



AWL PRESENTATION

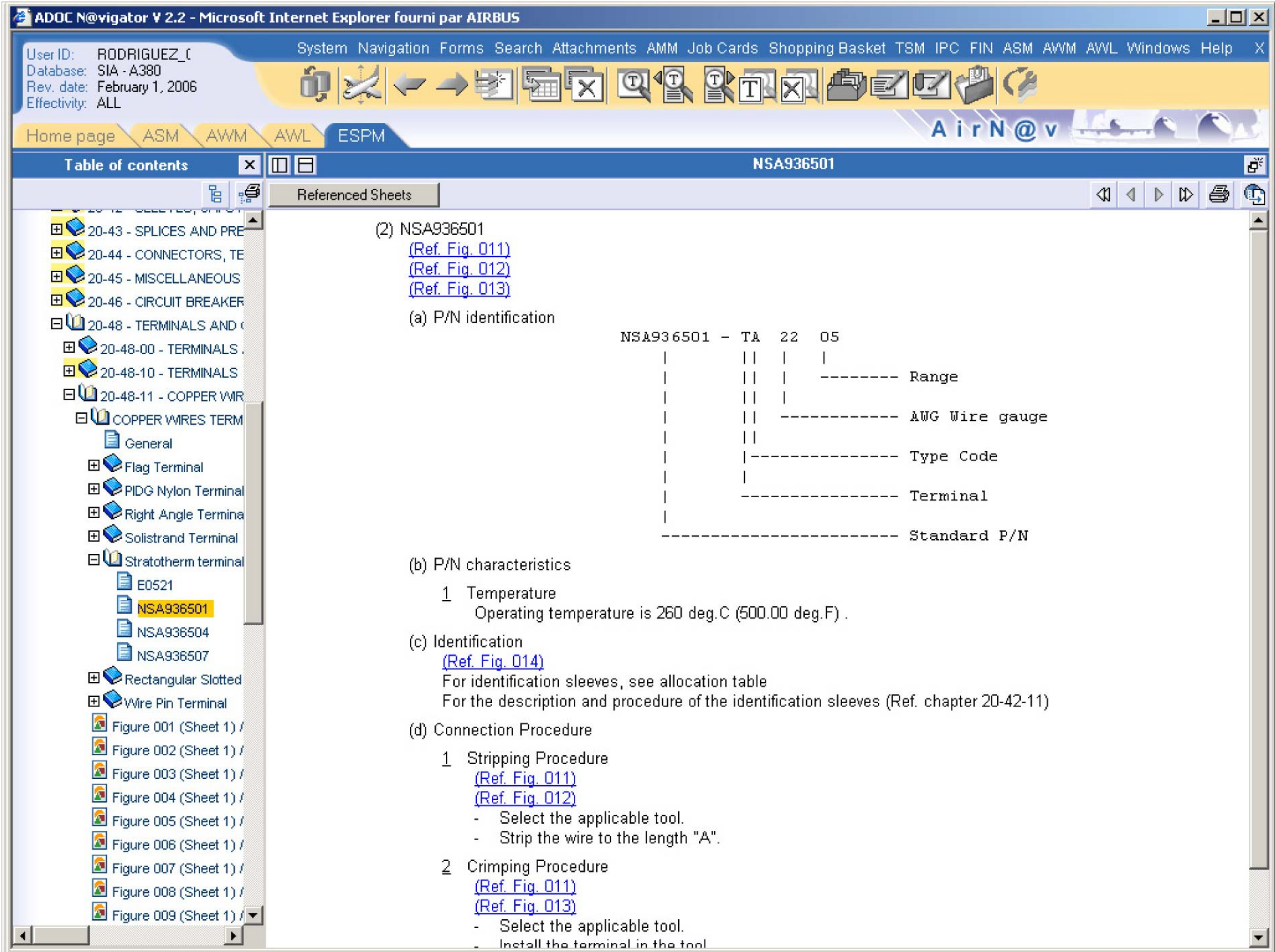
DOCUMENTATION-WIRING REPAIR (3)

ESPM Presentation



ESPM PRESENTATION

L1W06161 - L0KT0T0 - LM00O3LEVEL0301



ESPM PRESENTATION

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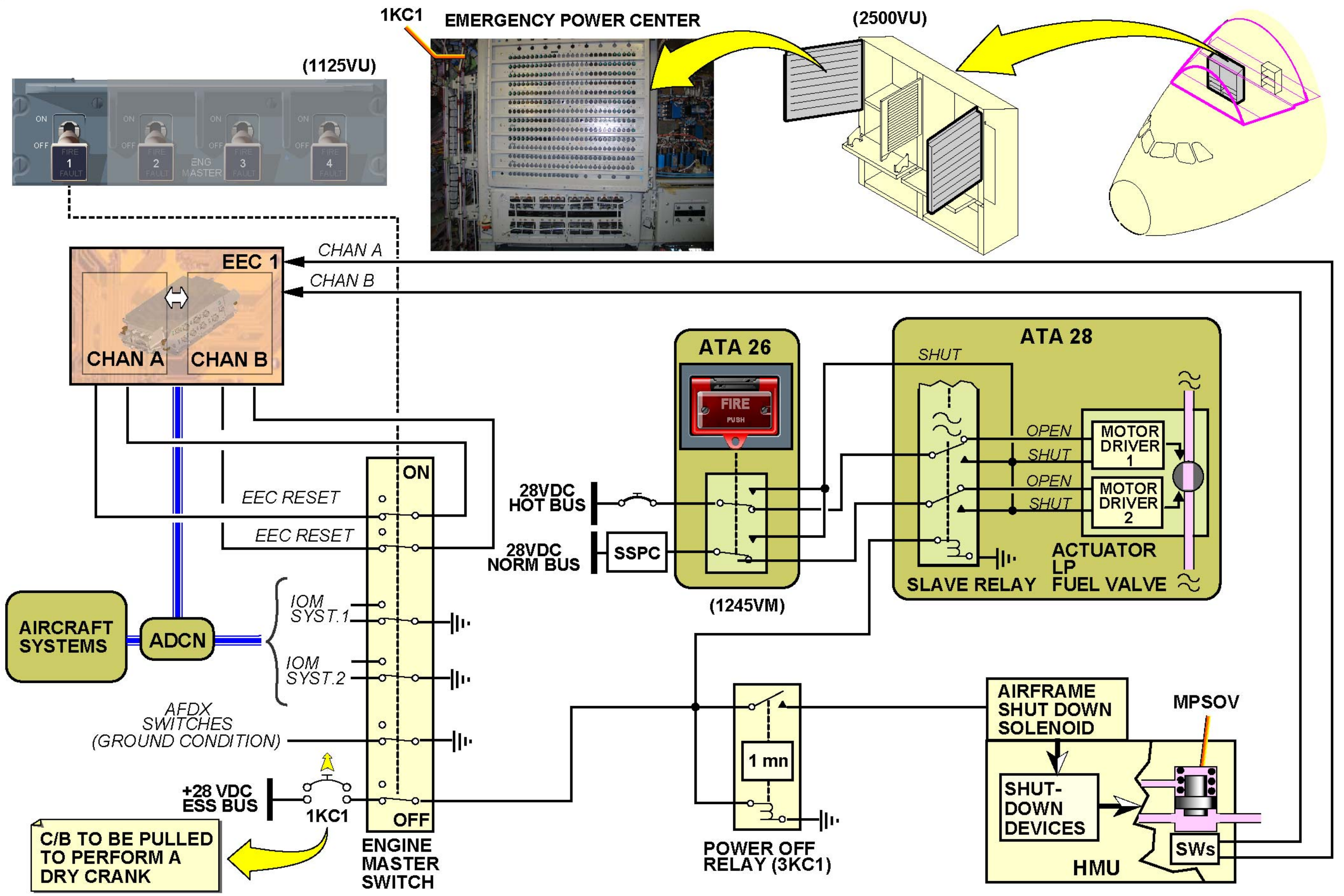
FUEL, OIL, AIR & IGNITION START MAINTENANCE (3)

LP and MP Shut-Off Valves Commands and Power Supply

The ENGine MASTER SW controls:
-The reset of the Engine Electronic Controller (EEC) A and B channels,
-The excitation of the ENG MASTER SW SLAVE relay, which controls the LP fuel valve actuator,
-The excitation of the airframe shut down solenoid, which controls the HP fuel valve actuator.
When the ENG MASTER lever is set to the "OFF" position, the 28 VDC ESSentiel bus supplies the slave relay. The slave relay switches the power supply from 28 VDC HOT BUS and 28 VDC NORMal bus to the "SHUT" position of the motor driver of the LP fuel valve
With ENG MASTER lever on the "OFF" position, the LP fuel valve can be open by pulling the breaker 1KC1, if the ENG FIRE P/B is not released.
To operate a dry crank the ENG MASTER lever must be set to the "OFF" position. When a dry crank is initiated, the fuel must lubricate the LP fuel pump, so the breaker 1KC1 (1, 2, 3 or 4) must be pulled.
The breaker 1KC1 (1, 2, 3 or 4) is located on the emergency power center (2500VU) in the emergency avionics compartment



LP AND MP SHUT-OFF VALVES COMMANDS AND POWER SUPPLY

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FUEL, OIL, AIR & IGNITION START MAINTENANCE (3)

Preservation Of The Powerplant

Cautions:

CAUTION: -YOU MUST DO ALL THE APPLICABLE PRESERVATION PROCEDURES WHEN YOU PUT AN ENGINE INTO STORAGE. IF YOU DO NOT, CORROSION AND GENERAL DETERIORATION OF THE CORE ENGINE AND THE FUEL SYSTEM CAN OCCUR.
-YOU MUST NOT KEEP THE ENGINE IN STORAGE FOR TOO LONG. THE TIMES GIVEN IN THIS PROCEDURE ARE THE MAXIMUM FOR WHICH THE ENGINE CAN BE PRESERVED. IF THE TIME THE ENGINE IS IN PRESERVATION IS TO BE EXTENDED, YOU MUST DO THE FULL PRESERVATION PROCEDURE AGAIN. IF THESES PROCEDURES ARE NOT FOLLOWED, DAMAGE TO ENGINE CAN OCCUR

The preservation procedure protects the RR TRENT 900 against corrosion, liquid and debris entering the engine and atmospheric conditions during periods of storage and inactivity.
The time during which the engine will be stored, and the climatic conditions of storage are shown in a chart.
This chart also gives the preservation procedures, which must be done in different conditions and for the different storage times. Refer to the Aircraft Maintenance Manual (AMM) for specific storage requests.
To find the applicable preservation procedure you have to:
- find the climatic condition in which the power plant will be stored,
- find the time during which the power plant will be stored,
- compare this data with the chart and make the decision as to which preservation procedures must be done.

Before a power plant is put in storage, these basic procedures must also be done:
- clean and examine the power plant,
- make sure the power plant is dry,
- clean the power plant if a fire extinguisher has been used on it.

For powerplants stored on-wing, desiccant must be used for protection.
According with the conditions and the time of storage the procedure can also composed of:
- Preservation of the main line bearings,
- Inhibit the engine fuel system,
- Attach the transportation covers,
- Remove the engine and install it in an MVP bag.

YOU MUST RESPECT THE APPLICABLE PRESERVATION PROCEDURES WHEN YOU PUT AN ENGINE INTO STORAGE YOU MUST RESPECT THE TIMES OF STORAGE. IF YOU DO NOT, CORROSION AND GENERAL DETERIORATION OF THE CORE ENGINE AND THE FUEL SYSTEM CAN OCCUR.

† THE ENGINE MUST BE STARTED OR THE FUEL SYSTEM MUST BE INHIBITED ON THE 31ST DAY OF STORAGE.
IF THE ENGINE FUEL SYSTEM IS NOT INHIBITED, THE ENGINE MUST BE STARTED EVERY 31 DAYS.

	CONDITION	STORAGE TIME	PRESERVE THE MAIN LINE BEARINGS	ATTACH THE COVERS AND THE SEALS	INHIBIT THE FUEL SYSTEM	INSTALL DESICCANT	INSTALL A REMOVED ENGINE IN AN MVP BAG
OUTSIDE	ARID -EG. DESERT	UP TO 30 DAYS		*			
		31 DAYS TO 3 MONTHS		*	†		
		3 TO 12 MONTHS		*	*		
	NON-ARID CLIMATE	UP TO 30 DAYS		*		*	
		31 DAYS TO 3 MONTHS		*	†	*	
		3 TO 12 MONTHS	*	*	*	*	*
INSIDE	CONSTANT TEMPERATURE AND HUMIDITY (AIR CONDITIONED)	UP TO 30 DAYS		*			
		31 DAYS TO 3 MONTHS		*	*		
		3 TO 12 MONTHS		*	*		
	NON-AIR CONDITIONED ENVIRONMEN	UP TO 30 DAYS		*		*	
		31 DAYS TO 3 MONTHS		*	*	*	
		3 TO 12 MONTHS	*	*	*	*	*

PRESERVATION OF THE POWERPLANT

L1W06161 - L0KT0T0 - LM7RY3000000001

FUEL, OIL, AIR & IGN/STARTING SYS COMP. LOC. (3)

A/C Zone 400

Engine Oil Components

Engine Fuel Components

Engine Air Components (Including From ATA 36)

Engine Start and Ignition Components

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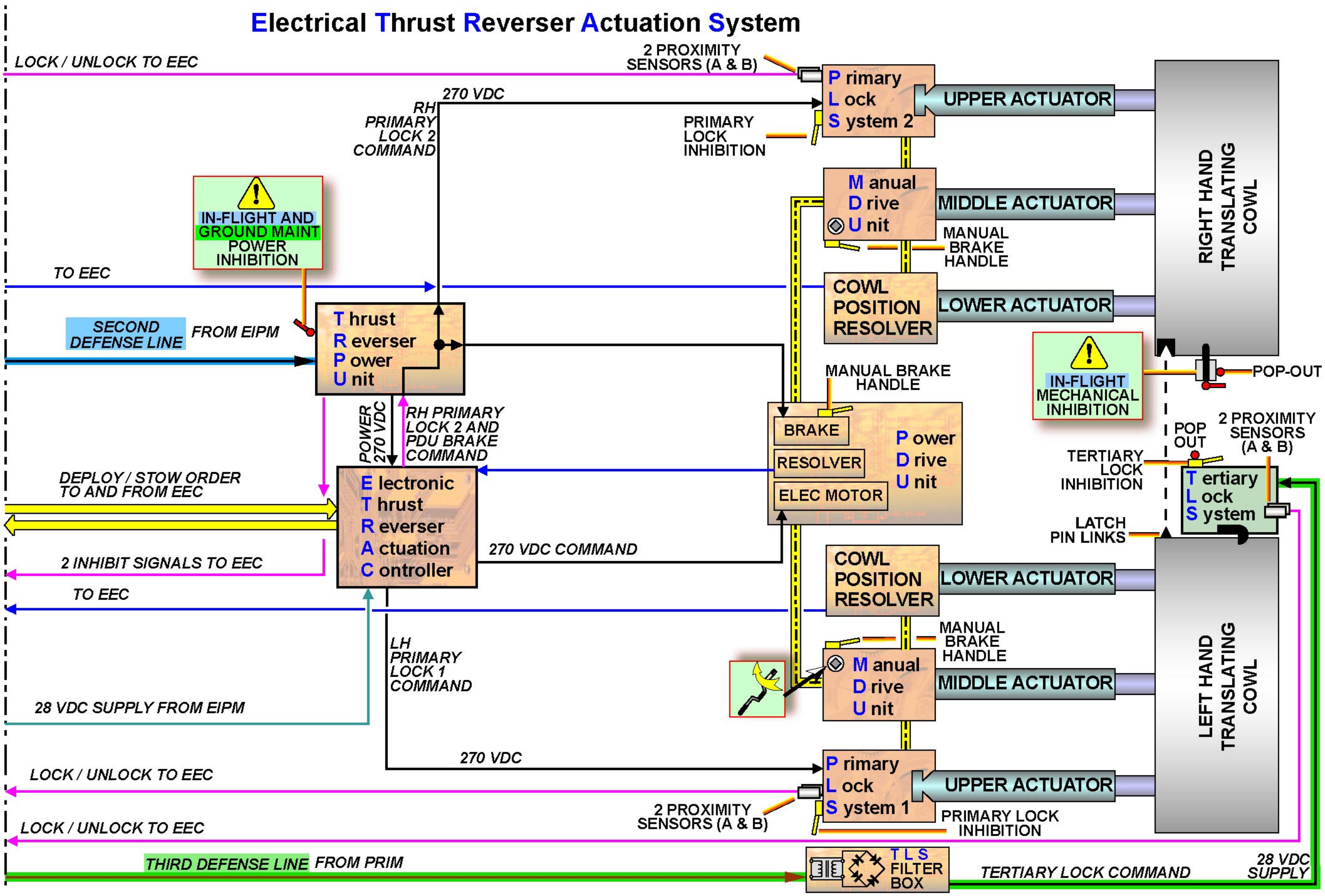
THRUST REVERSER MAINTENANCE (3)

Manual Deploy/Stow the Thrust Reverser Translating Cowl

The procedure to manually deploy the thrust reverser translating cowl is:
- Make the thrust reverser unserviceable for maintenance (Thrust Reverser Power Unit (TRPU) inhibition),
- Make the Tertiary Lock System (TLS) of the thrust reverser unserviceable,
- Unlock the Primary Lock System (PLS) of right thrust reverser
- Release the brake of the Power Drive Unit (PDU),
- Unlock the PLS of left thrust reverser
- Make the right and left Manual Drive Units (MDUs) of the thrust reverser operative,
- Manually deploy the thrust reverser translating cowl,
- Make the right and left MDUs of the thrust reverser inoperative.

The procedure to manually stow the thrust reverser translating cowl is:
- Make the thrust reverser unserviceable for maintenance,
- Make the TLS of the thrust reverser unserviceable,
- Make the right and left MDU of the thrust reverser operative,
- Active the PLS of the right thrust reverser
- Active the PLS of the left thrust reverser
- Manually stow the thrust reverser translating cowl,
- Make the right and left MDU of the thrust reverser operative,
- Active the brake of the PDU.



MANUAL DEPLOY/STOW THE THRUST REVERSER TRANSLATING COWL

THRUST REVERSER MAINTENANCE (3)

Manual Deploy/Stow the Thrust Reverser Translating Cowl (continued)

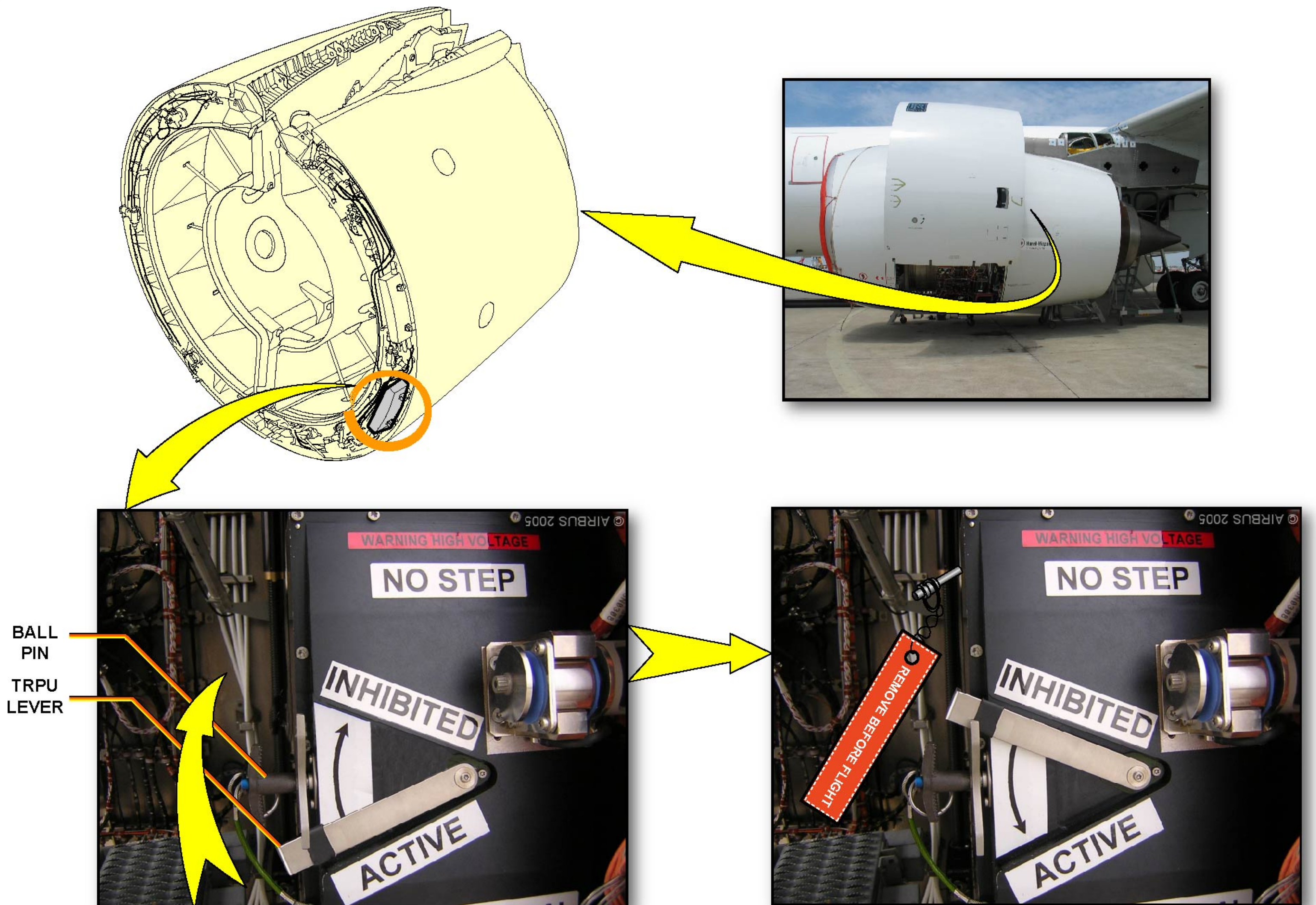
Make the Thrust Reverser Unserviceable for Maintenance

WARNING: YOU MUST MAKE THE THRUST REVERSER UNSERVICEABLE (INSTALLATION AND SECURIZATION OF THE INHIBITION DEVICE) BEFORE YOU DO A WORK ON OR AROUND THE THRUST REVERSER. IF YOU DO NOT INSTALL AND SECURE THE INHIBITION DEVICE, YOU CAN CAUSE ACCIDENTAL OPERATION OF THE THRUST REVERSER AND INJURY TO PERSONS AND/OR DAMAGE TO THE EQUIPMENT.

The opening of fan cowl doors gives access to the TRPU.
To make the TRPU unserviceable, you must:
- Remove the ball pin from the TRPU,
- Move the TRPU lever to the "inhibited" position,
- Install the ball pin on the TRPU,

CAUTION: AFTER INSTALLATION OF THE BALL PIN, CHECK THAT THE BALL PIN IS CORRECTLY INSTALLED BY PULLING IT.

- Install the lock out pin with the "Remove Before Flight" flag in the TRPU hole.



TRPU ON "ACTIVE" POSITION

TRPU ON "INHIBITED" POSITION

MANUAL DEPLOY/STOW THE THRUST REVERSER TRANSLATING COWL - MAKE THE THRUST REVERSER UNSERVICEABLE FOR MAINTENANCE

THRUST REVERSER MAINTENANCE (3)

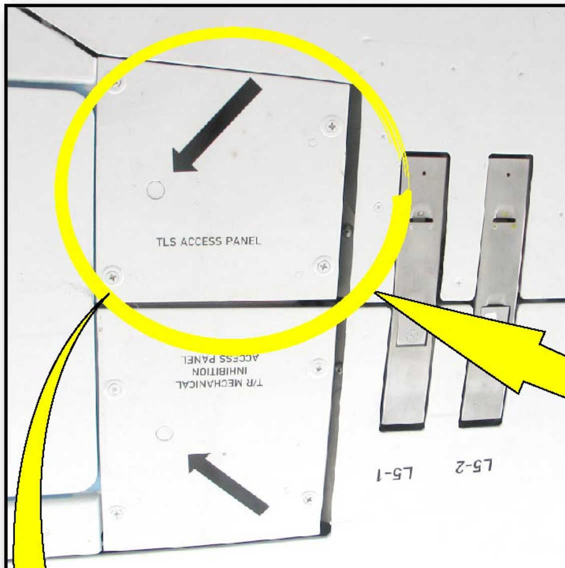
Manual Deploy/Stow the Thrust Reverser Translating Cowl (continued)

Make the TLS of the Thrust Reverser Unserviceable

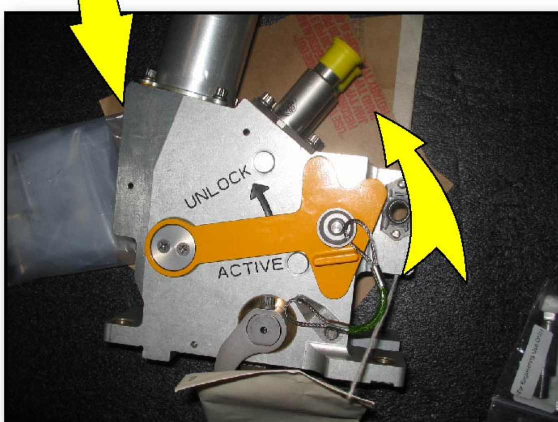
WARNING: -IF YOU INHIBIT THE THRUST REVERSER ENGINE 2, YOU MUST INHIBIT THE THRUST REVERSER ENGINE 3 AND OPPOSITE.
-YOU MUST MAKE THE THRUST REVERSER UNSERVICEABLE (INSTALLATION AND SECURIZATION OF THE INHIBITION DEVICE) BEFORE YOU DO A WORK ON OR AROUND THE THRUST REVERSER. IF YOU DO NOT INSTALL AND SECURE THE INHIBITION DEVICE, YOU CAN CAUSE ACCIDENTAL OPERATION OF THE THRUST REVERSER AND INJURY TO PERSONS AND/OR DAMAGE TO THE EQUIPMENT.

Thrust reverser TLS is located at the lower part of the thrust reverser behind the mechanical inhibition access door
To make the thrust reverser TLS unserviceable, you must:
- Remove the ball pin from the TLS,
- Move the yellow lever on the "UNLOCKED" position,
- Install the ball pin to lock the lever.

When the access door is closed, make sure that the visual pop-out is visible.

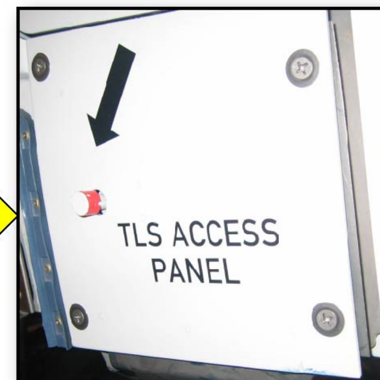


TLS ACCESS PANEL



TLS "ACTIVE" POSITION

TLS "UNLOCKED" POSITION



TLS POP-OUT REALEASED

MANUAL DEPLOY/STOW THE THRUST REVERSER TRANSLATING COWL - MAKE THE TLS OF THE THRUST REVERSER UNSERVICEABLE

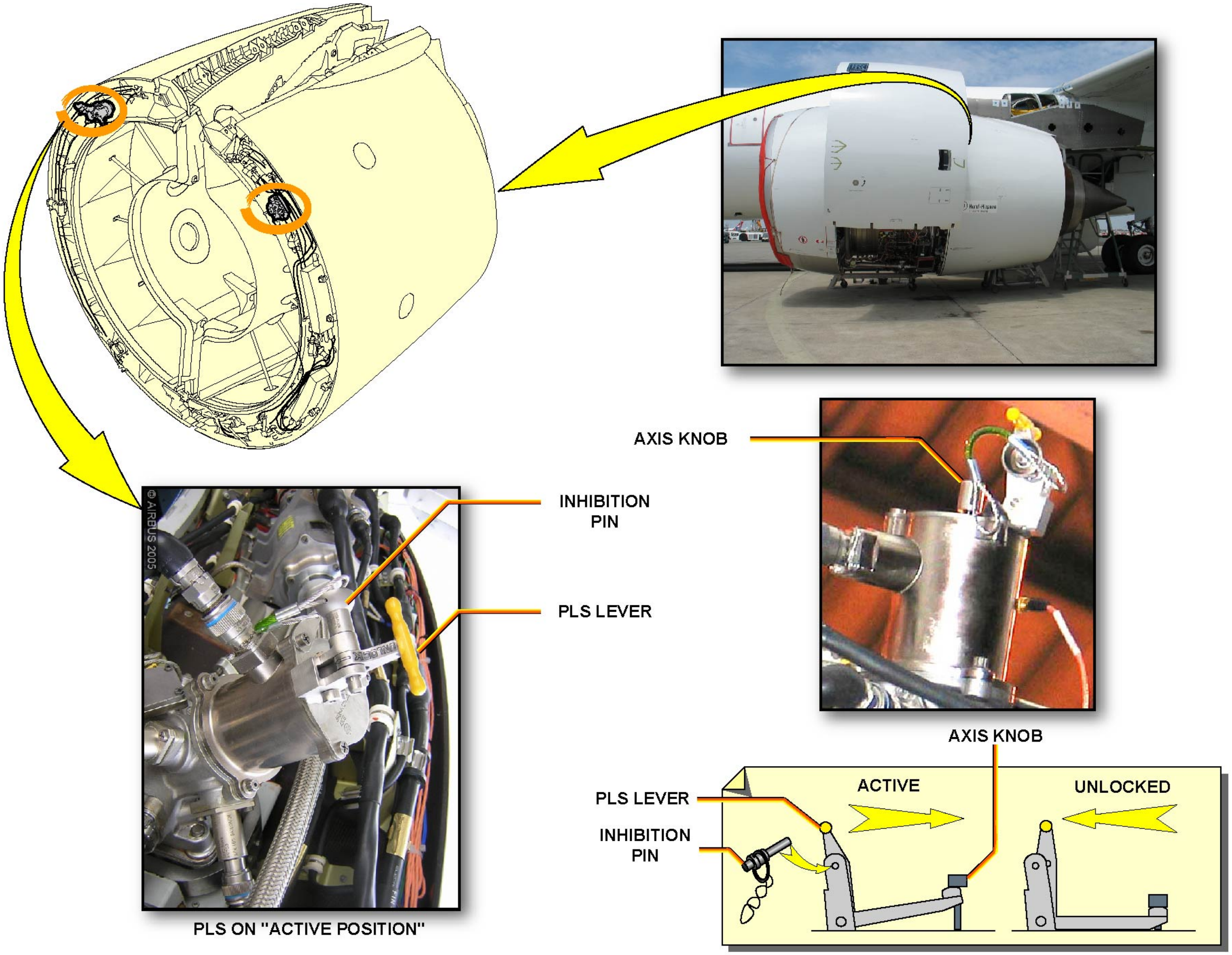
THRUST REVERSER MAINTENANCE (3)

Manual Deploy/Stow the Thrust Reverser Translating Cowl (continued)

Unlock/Active the PLS of the Thrust Reverser

There are two PLSs per engine. The opening of fan cowl doors gives access to PLSs
To unlock the PLS of the thrust reverser, you must:
- Remove the inhibition pin from the end of the lever,
- Rotate the lever to put the translating axis knob in the "UNLOCKED" position,
- Install the inhibition pin at the end of the lever.

To active the PLS of the thrust reverser, you must:
- Remove the inhibition pin from the end of the lever,
- Rotate the lever to put the translating axis knob in the "ACTIVE" position,
- Install the inhibition pin at the end of the lever.



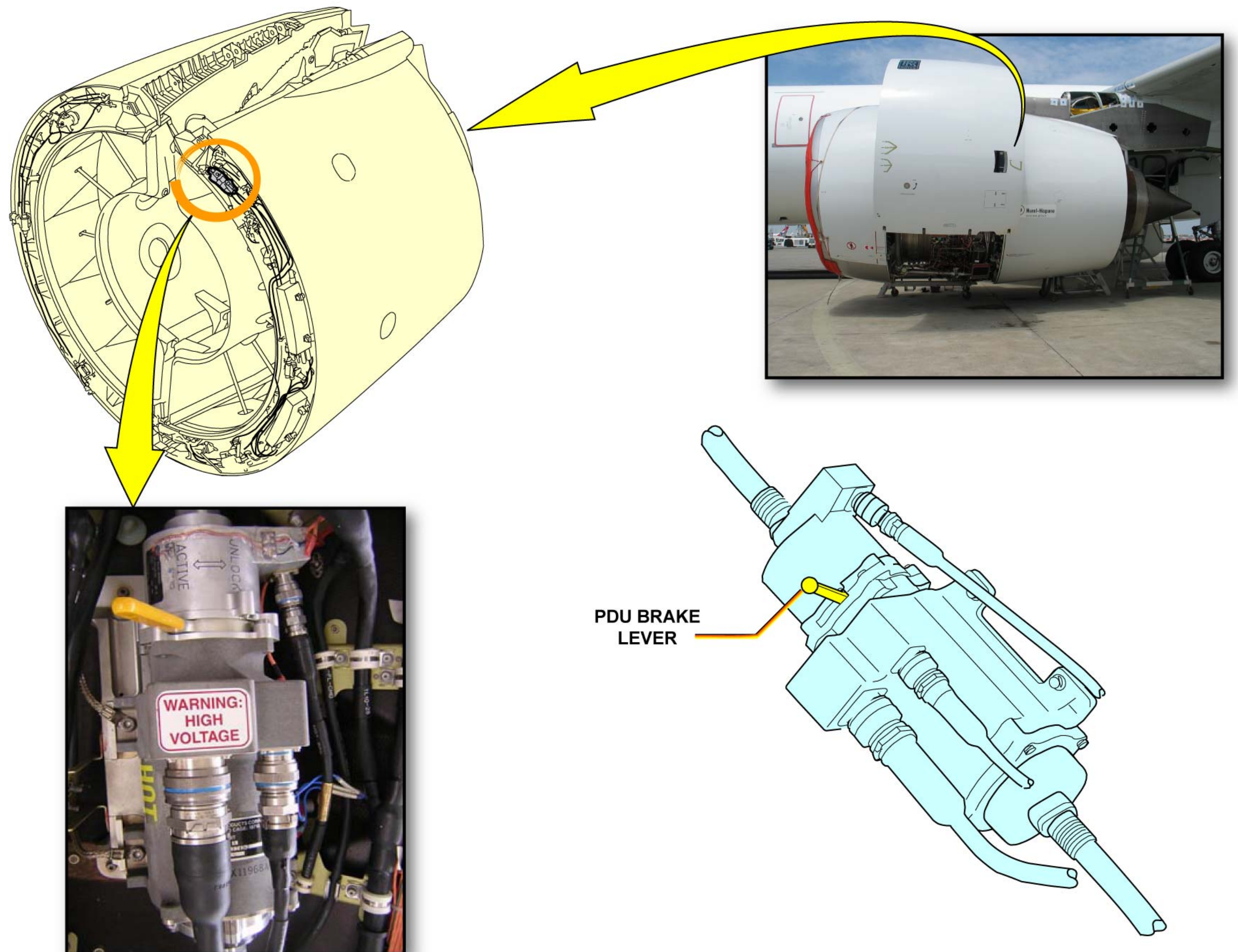
MANUAL DEPLOY/STOW THE THRUST REVERSER TRANSLATING COWL - UNLOCK/ACTIVE THE PLS OF THE THRUST REVERSER

THRUST REVERSER MAINTENANCE (3)

Manual Deploy/Stow the Thrust Reverser Translating Cowl (continued)

Release/Active the Brake of the PDU

The Power Drive Unit (PDU) is installed behind the fan cowl doors.
To release the brake of the PDU, you must:
-Move the yellow lever to the "UNLOCKED" position.
To active the brake of the PDU, you must:
-Move the yellow lever to the "ACTIVE" position.



PDU BRAKE LEVER IN THE "ACTIVE" POSITION

PDU BRAKE LEVER IN THE "UNLOCKED" POSITION

MANUAL DEPLOY/STOW THE THRUST REVERSER TRANSLATING COWL - RELEASE/ACTIVE THE BRAKE OF THE PDU

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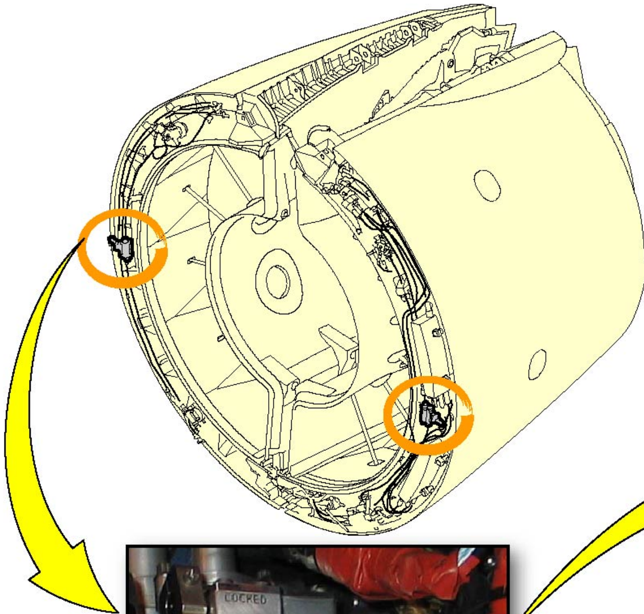
THRUST REVERSER MAINTENANCE (3)

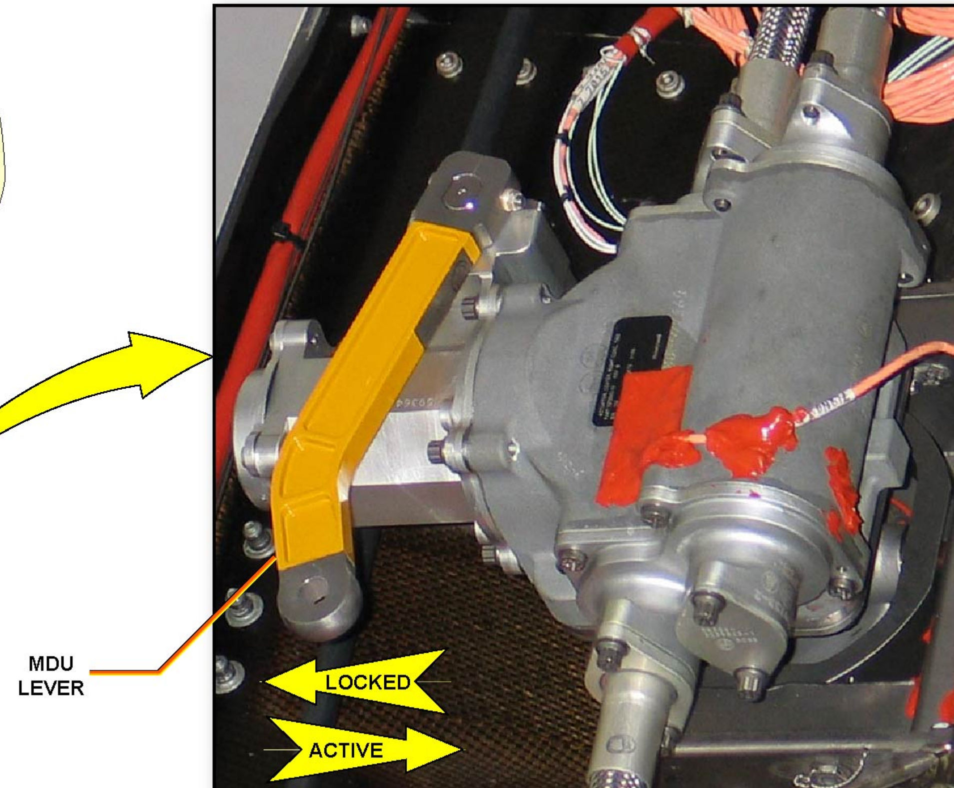
Manual Deploy/Stow the Thrust Reverser Translating Cowl (continued)

Make the MDUs of the Thrust Reverser Operative/Inoperative

There are two Manual Drive Units (MDUs) per engine. They are installed behind the fan cowl doors.
To Make the MDUs of the thrust reverser operative, you must:
- Make sure that the yellow levers of the two MDUs are on the "ACTIVE" position,
- If not, move them on the "ACTIVE" position.
- To Make the MDUs of the thrust reverser inoperative, you must:
- Make sure that the yellow levers of the two MDUs are on the "LOCKED" position,
- If not, move them to the "LOCKED" position.



MANUAL DRIVE UNIT`



MANUAL DRIVE UNIT`

MANUAL DEPLOY/STOW THE THRUST REVERSER TRANSLATING COWL - MAKE THE MDUS OF THE THRUST REVERSER OPERATIVE/INOPERATIVE

THRUST REVERSER MAINTENANCE (3)

Manual Deploy/Stow the Thrust Reverser Translating Cowl (continued)

Manually Deploy/Stow the Thrust Reverser Translating Cowl

To manually deploy the translating cowl of the thrust reverser, you must:
- Put the 3/8 inch speed wrench at the MDU,

NOTE: Note: make sure that the male square drive of the speed wrench is correctly engaged in the MDU, before you turn the MDU.
Note: you can use special pneumatic or electrical tool to turn the MDU.

- Push and turn the MDU clockwise to deploy the translating cowl of the thrust reverser until the MDU torque limiter releases,

NOTE: Note: The translating cowl can be deployed either with the left MDU or with the right MDU.

- Remove the speed wrench.

To manually stow the translating cowl of the thrust reverser, you must:
-Put the 3/8 inch speed wrench at the MDU,

NOTE: Note: make sure that the male square drive of the speed wrench is correctly engaged in the MDU, before you turn the MDU.
Note: you can use special pneumatic or electrical tool to turn the MDU.

- Push and turn the MDU counter-clockwise to stow the translating cowl of the thrust reverser until the MDU torque limiter releases,

NOTE: Note: The translating cowl can be stowed either with the left MDU or with the right MDU.

- Remove the speed wrench.

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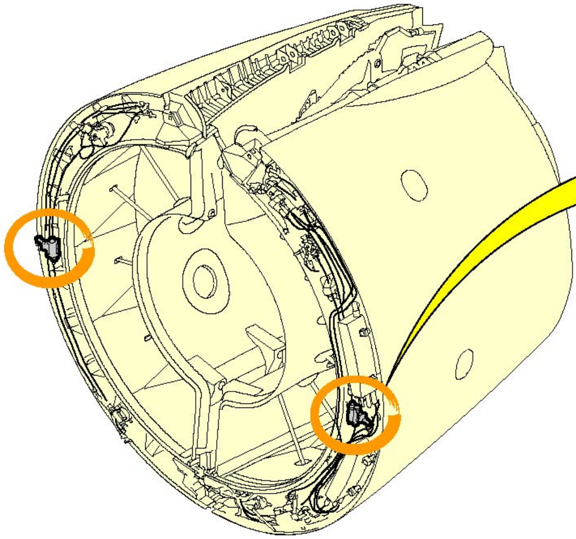
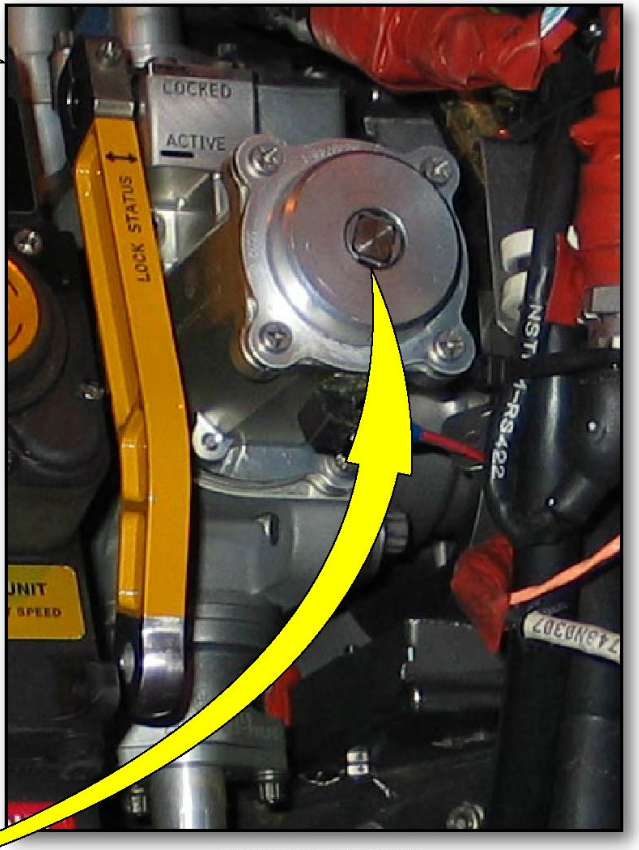
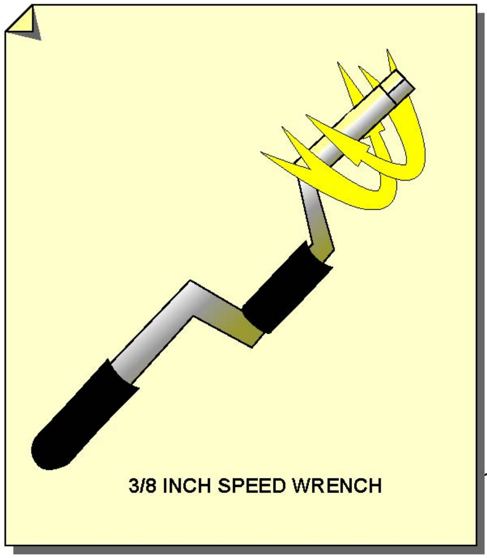




POWER DRIVE UNIT`



3/8 INCH SPEED WRENCH

MANUAL DEPLOY/STOW THE THRUST REVERSER TRANSLATING COWL - MANUALLY DEPLOY/STOW THE THRUST REVERSER TRANSLATING COWL

THRUST REVERSER SYSTEMS COMPONENT LOCATION (3)

Engine Fan Exhaust Cowl (FOC Outboard) and Thrust Reverser Cowl (Inboard)

A/C Zone 400

Cockpit and OMT

A/C Zone 210

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